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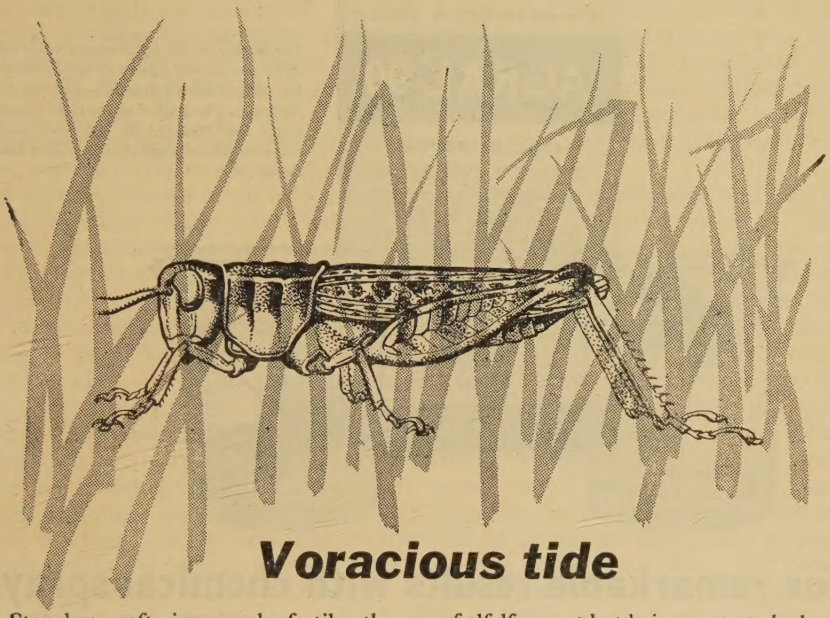

Voracious tide

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For the advance of the pampa grasshoppers is tide-like in its relentlessness. *Tucura*, the *criollos* call them, 'locust-like' in their rapacity. Nothing green or growing is immune to their feeding, and when the tide has passed the hot wind of the pampa blows over a stubbled waste of destruction.

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TREATMENT	PERCENTAGE OF 'PERENOX' IN SPRAY FLUID	MEAN NUMBER OF SPOTS PER LEAF	
		April 26th	May 20th
'PERENOX'	0.25	12	109
'PERENOX'+ 'AGRAL' LN	0.25+ 15 CC/100 LITRES	0.5	39

Spray dates: 9th March, 30th March, 20th April.

'Agral' LN has also been used successfully for the control of potato blight with 'Perenox', the control of apple mildew with 'Spersul', and with sodium nitrate and sodium arsenite weedkillers.

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Cumber (R. A.). **Ecological Studies of the Rhinoceros Beetle** *Oryctes rhinoceros* **(L.) in Western Samoa.**—*Tech. Pap. S. Pacif. Comm.* no. 107, vi + 32 pp., 38 figs., 6 refs. Nouméa, 1957.

The investigations described in this report formed part of the work undertaken under the auspices of the South Pacific Commission to provide the maximum degree of control of *Oryctes rhinoceros* (L.) on coconut in Pacific areas through the use of field practices and biological control methods. Western Samoa [*cf. R.A.E.*, A **42** 104], where the Dynastid became established in 1909, was selected as a research centre, and Utumapu, on Upolu, served as the main experimental area.

The report consists of an introduction, in which the distribution and habits of the beetle are briefly described [*cf.* **42** 103], and six main sections. The first of these comprises an account of studies in connection with the use of trap logs for control of the adults, and the following is based on the author's summary of the results. Traps consisting of split coconut logs proved at least twice as effective as whole logs, in which it is difficult to detect incipient breeding. Split logs attract the beetles for as long as they remain intact, but their attractiveness decreases with the decomposition of the wood. Traps consisting of about 12 split logs were the most useful. They are best placed in the open along the margins of severely infested areas, at a distance of about 25 yards from the plantation; damp conditions and undergrowth should be avoided. The beetles each spend about two days at a time beneath the logs, and collections should therefore be made twice a week in normal weather; during rain, the beetles remain in the crowns of the palms. If traps are to be effective, close supervision is necessary. They are most useful in a locality where the beetle is out of control and the margins of the plantation are receding as a result of the attack, so that suitable trunks are available, and they should be used only on a large scale, other dead wood being removed from the area. The beetles were found to be more mobile than had been thought, marked individuals being recaptured at distances of 1,000 yards three days after release, and a mile after a month. They survive on the average for some 2–3 months in the field, most of the time being spent in the crowns of the palms. They probably make 3–4 visits to ground wood during life, returning to a fresh palm each time, so that 3–4 palms may be damaged by one beetle.

The second section is devoted to studies on the distribution of damage. Coconut plantations in Samoa mostly lie in a belt parallel to the coast, with salients running inland and upwards. Breeding is heavy in non-plantation areas where jungle has been cleared, and this, together with the vulnerability of margins and the less vigorous growth at high altitudes, makes inland salients and margins very susceptible to injury. In village plantations in the coastal belt, damage is sporadic and of a minor nature.

The third section comprises a review of the more important breeding media, which are wood lying on the ground in newly felled jungle areas, the felled trunks and the stumps of coconut palms, other scattered wood, refuse, compost and sawdust, and the fourth section consists of miscellaneous notes. The beetles varied greatly in size, presumably as a result of differences in larval nutrition. When wing length was the criterion, females were slightly larger than males, and the largest individuals were taken in February–June. The results of dissections indicated that a period of active feeding by the adult female precedes ovarian development, and it seemed likely that plant sap is required. Females survived longer than males on an average; 50 per cent. of young beetles survived in captivity for 7–8 weeks, and the maxima were 12–13 weeks for males and 17–18 for females. In one case, breeding was observed in dead wood on a living palm.

The general results of the work and the present status of the beetle in

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Western Samoa are discussed in the fifth section, and long-term measures to reduce infestation are reviewed in the sixth. These comprise mainly field sanitation, with trapping and hand-collection by climbers, and the consolidation of areas under coconut and their isolation from the central jungle.

Work on biological control of *O. rhinoceros* in Western Samoa in 1954–55 is reviewed in an appendix. In 1954, two smears of each of two bacilli that were originally found in Australia were received from the United States. The bacilli had been isolated from larvae of *Sericesthis pruinosa* (Dalm.) and *Heteronychus sanctae-helenae* Blanch., respectively, and tentatively named *Bacillus lentimorbus* var. *australis* and *B. euloomarahae* [**46** 191]. Injection of spores of either species into the coelomic cavity of third-instar larvae of *O. rhinoceros* resulted in some deaths, but there was no rapid multiplication of the bacilli and the work was discontinued. Steinhaus had previously found in the Palau Islands that the larvae were not very susceptible to *B. popilliae*, *B. lentimorbus* or *B. thuringiensis*. Three shipments of the predacious Elaterids, *Lanelater* (*Agrypnus*) *fuscipes* (F.) and *Alaus speciosus* (L.), were received in 1955 from Ceylon, where they were stated to be common in coconut logs and stumps, and liberations were subsequently made.

Cohic (F.). **Parasites animaux des plantes cultivées en Nouvelle-Calédonie et dépendances.**—[1+] 91 [+1] pp., multigraph. Nouméa, Inst. franç. Océanie, 1956.

The pests here recorded from New Caledonia and its dependencies are nearly all insects that attack cultivated plants, stored products or timber. They are arranged in two lists, one showing the pests that attack the various plants or products, and the other showing the plants or products attacked by the pests. A few parasites and predators of plant pests are included, and a short list of entomogenous fungi showing the insects that they infest is appended.

Laird (M.). **Wartime Collections of Insects from Aircraft at Whenuapai.** —*N.Z. J. Sci. Tech.* **38** (B) no. 2 pp. 76–84, 28 refs. Wellington, N.Z., 1956.

A list is given of about 100 species of insects representing 49 families and ten orders that were collected at Whenuapai Airport, New Zealand [*cf. R.A.E.*, A **41** 409] in 16 aircraft arriving from the New Hebrides, New Caledonia and Fiji in 1943–44. It shows the numbers of aircraft in which they were found and the islands from which they came, and is followed by brief notes on some of them. Those of agricultural importance included *Leptocorisa varicornis* (F.), *Spodoptera mauritia* (Boisd.), *Nacoleia* (*Lamprosema*) *diemenalis* (Gn.), *Hymenia recurvalis* (F.), and a species of *Dacus* tentatively determined as *D. passiflorae* Frogg.

Brimblecombe (A. R.). **Destructive Wood Borers and their Damage.**—*Pamphl. Div. Pl. Ind. Dep. Agric. Qd* no. 165, 43 pp., 61 figs. Brisbane [1956].

Wood-boring insects are common in Queensland and cause considerable damage to living trees in forests, plantations and regeneration areas, to logs and sawn timber, and to wood in manufactured articles and buildings. Notes are given in this pamphlet on the species responsible for the damage, with special reference to their appearance and bionomics and the type of injury caused. Apart from a few moths, all are beetles.

Djojopranoto (A.). **Kepik lantana dipulau Timor** (*Teleonemia scrupulosa* **Stål).** [The Lantana-bug (*T. scrupulosa*) on the Island of Timor.]—*Tehnik Pertanian* **6** no. 3 repr. 19 pp., 7 figs., 10 refs. Bogor, 1957. (With a Summary in English.)

The following is taken from the author's summary. As a result of the escape of *Teleonemia scrupulosa* Stål from the laboratory in Bogor in 1940 [*cf. R.A.E.*, A **42** 366], this Tingid spread all over Java, the Lesser Sunda Islands and Celebes within ten years. In 1954, it was deliberately introduced into Timor for the control of *Lantana camara*. It had been feared that it might prove injurious to teak (*Tectona grandis*) there, and in experiments the bugs were seen sucking the leaves of this tree, causing damage similar to that caused on *Lantana*, but they did not survive for more than five days on them as compared with a normal life of 42–60 days. When *Lantana* leaves were placed close to infested teak leaves, the bugs migrated to them at once and began to reproduce. They appeared useless for the control of *Lantana*, however, since they were washed away in the wet monsoon period and the infested bushes grew again.

Oka (I. N.). **Pertjobaan laboratorium dalam pemberantasan ulat kubis** *Plutella maculipennis* **Curt. dengan** *Bacillus thuringiensis* **Berl.** [Laboratory Experiments on the Control of *P. maculipennis* with *B. thuringiensis*.]—*Tehnik Pertanian* **6** no. 4 pp. 113–134, 4 figs., 13 refs. Bogor, 1957. (With a Summary in English.)

The following is based on the author's summary. *Plutella maculipennis* (Curt.) has proved difficult to control on cabbage in parts of Indonesia [*cf. R.A.E.*, A **41** 441; **43** 350], and laboratory experiments were therefore carried out on the effectiveness against it of *Bacillus thuringiensis*, which is pathogenic to the larvae of many Lepidoptera. The bacillus was cultivated on agar from growing seeds of *Phaseolus aureus* (*radiatus*) to which 2 per cent. glucose was added, and a powder was prepared from the dried spores. Larvae that fed on leaves sprayed with a suspension of this became inactive in a short time and died after about 24 hours. When nearly full-grown cabbage plants in pots were sprayed, complete mortality of larvae subsequently placed on them was given in two days by 5–15 ml. per plant of a suspension containing 2,500 million spores per ml. and in 3–4 days by 10–15 ml. of a suspension of 250 million per ml.; 5 ml. suspension containing 125 million spores per ml. gave nearly 95 per cent. kill in eight days.

Matsumoto (S.) & Shimazaki (T.). **On the Development of the European Corn Borer,** *Pyrausta nubilalis* **Hübner. (Preliminary Report.)** [*In Japanese.*]—*Res. Bull. Hokkaido nat. agric. Exp. Sta.* no. 72 pp. 22–27, 1 graph, 13 refs. Sapporo, 1957. (With a Summary in English.)

Pyrausta nubilalis (Hb.) usually has only one generation a year, but a partial second generation is produced on maize in Hokkaido, its size apparently depending on weather conditions, especially on temperature and moisture in winter and spring. Experiments in 1955 showed that the theoretical zero points of development were 13, 11·2 and 12·6°C. [55·4, 52·16 and 54·68°F.], and the total effective temperatures 50, 365 and 91 day-degrees C. for the egg, larva and pupa, respectively. Within a temperature range of 19–25°C. [66·2–77°F.], larvae of the first generation that reached the final instar by the end of July did not enter diapause and the proportion that entered it thereafter increased as the date was delayed. A similar trend was observed in the field, so that the incidence of diapause

appears to be closely related to the time of year at which the larvae are active. When hibernating larvae were incubated at 25°C. at various dates between November and April, the periods to adult emergence were almost the same, indicating that diapause was completed by November. The velocity of development of the overwintered larvae was influenced by relative humidity, the duration of development before pupation being decreased by humid conditions.

Manocha (B. D.) & Gupta (D. S.). **Locust Control in Kuwait.**—*Indian J. Ent.* **18** (1956) pt. 3 pp. 211–218, 3 figs., 2 maps, 3 refs. New Delhi, 1957.

Kuwait lies in the path of the seasonal migrations of *Schistocerca gregaria* (Forsk.) [*cf. R.A.E.*, A **40** 321], and breeding occurs there in spring. The territory is flat, sandy and treeless, with scrub vegetation that becomes abundant in the rainy season (between September and May), and contains little cultivated land and few natural enemies of locusts, which are welcomed by the nomads for food. As swarms migrating from Kuwait constitute a threat to adjacent countries, control measures were carried out by the Desert Locust Control Organisation in 1952–54 and by the Government of India in 1955. Hatching is reported to occur from late March until May and adult emergence from late April until June, unless there is early rain, when hatching occurs in February and March and the adults emerge in March and April. In 1955, surveys of infested areas were begun in February, and control operations were carried out in five localities in Kuwait and one in the neutral territory to the south between mid-April and mid-May. Egg beds could not be treated for lack of spraying facilities, but the hoppers were successfully controlled, mainly in the early stages, by dusting with 6–15 lb. 10 per cent. BHC per acre or with a bait of BHC in wheat bran. As a result, no swarms left the area, and locust activity was low in India and Pakistan during the summer breeding season of 1955.

Prasad (V. G.) & Mukerji (S.). **Seasonal Variations in *Pyrilla perpusilla* Walker in India.**—*Indian J. Ent.* **18** (1956) pt. 3 pp. 219–225, 2 figs., 16 refs. New Delhi, 1957.

In view of doubt as to the identity of the species of *Pyrilla* on sugar-cane in India [*cf. R.A.E.*, A **26** 8; **32** 393], further investigations were begun in 1952. Representative collections of the different forms were obtained from districts in Bombay, Madras, the Punjab, Bihar and Uttar Pradesh, and living examples for breeding from Bihar and Delhi. When they were grouped according to coloration and seasonal occurrence, it was found that four forms were present. These are briefly described. The three main ones are referred to as the monsoon-autumn form, the autumn-winter form, and the winter-spring-summer form. Of these, the last was the commonest, and was identical with the typical *P. perpusilla* (Wlk.), and the other two bore considerable resemblance to the original descriptions of *P. aberrans* (Kby.) and *P. pusana* Dist., respectively. No constant differences were observed in the male or female genitalia, and the three forms interbred. It is concluded that *P. aberrans* and *P. pusana* are seasonal varieties of *P. perpusilla* and that their occurrence depends mainly on suitable combinations of temperature and humidity. The fourth form, which was named *P. perpusilla* var. *nigriventris* by Mukerji & Prasad in 1955, was found on sugar-cane near Delhi in December–March. It did not interbreed with other forms and may represent a distinct species.

Teotia (T. P. S.) & Pathak (M. D.). **Bionomics of the Sann-hemp Shoot Borer, *Enarmonia pseudonectis* Meyr. (Eucosmidae: Lepidoptera) in the Uttar Pradesh.**—*Indian J. Ent.* **18** (1956) pt. 3 pp. 233–242, 17 figs., 9 refs. New Delhi, 1957.

Crotalaria juncea is an important crop in Uttar Pradesh, where it is attacked by *Cydia* (*Enarmonia*) *pseudonectis* (Meyr.), *Utetheisa pulchella* (L.), *Etiella zinckenella* (Treitschke) and *Argina* spp. The first is the most destructive, as it attacks the plant in all stages of growth, and an account is given of laboratory and field investigations on its bionomics. Males and females occurred in about equal numbers and survived for four and seven days, respectively, when they were provided with sugar syrup. The females deposited 148–278 eggs each, at the rate of 15–117 per day, on the upper surface of the topmost leaves, usually singly, but sometimes in groups of 2–7. The preoviposition and oviposition periods lasted 2–4 and 3–5 days, and the egg, larval and pupal stages 3–6, 11–22 and 4–9 days, respectively, depending on season. The larvae bored into the top shoots during July and August and into the leaf axils after mid-August, causing the formation of galls and the production of numerous side shoots. They fed in the seeds when the crop came into bearing. The attack continued from the second week of July until the first week of November and was most severe in September and October, when all plants were infested under suitable conditions and as many as seven galls per plant were found. The larvae pupated in the soil, or sometimes in the galls or between two shoots that had been webbed together. There were up to seven generations a year, and winter was passed by the full-grown larvae in cocoons in the soil. *C. pseudonectis* has been considered by some to feed only on *Crotalaria juncea*, but the larvae were also observed causing stem galls on *Sesbania bispinosa* (*aculeata*) [*cf.* also *R.A.E.*, A **9** 272]. The immature stages are described.

Sharangapani (M. V.) & Pingale (S. V.). **A Study of the Movements of some Insect Pests through Grain stored in Bags.**—*Indian J. Ent.* **18** (1956) pt. 3 pp. 243–250, 5 refs. New Delhi, 1957.

As effective control of insects infesting grain stored in bags by means of insecticides applied to the surfaces of the stacks depends on the outward movement of the insects from within the bags, investigations were made on the movement of *Rhizopertha dominica* (F.), *Latheticus oryzae* Waterh. and the small strain of *Calandra* (*Sitophilus*) *oryzae* (L.), which are commonly encountered in grain warehouses, through wheat stored in jute bags.

When bags containing immature stages were included in the second layer from the top of four-layer stacks, population counts made 15 days later showed that most *Rhizopertha* adults remained in the bags in which they emerged, whereas most adults of *L. oryzae* and *C. oryzae* left them, moving predominantly downwards. Counts made 1–4 weeks after adults of all three species had been released at the top or bottom of uninfested stacks or half way up indicated that those from the top moved down and then up again and those from the bottom upwards, the downward movement being vertical and rapid, and the upward one slower and more spreading. A layer of wheat of about 15·5 per cent. moisture content in a stack with a moisture content of about 12·2 per cent. reduced the movement of all species, owing to a preference for the moister grain, and comparison of the positions of insects released at the centre of the top layer of one stack that was kept in the dark and another kept in daylight showed that light checked their spread. Similar comparison in stacks subjected to a current of air of about 12 miles per hour for 15 minutes at intervals of an hour and not so subjected indicated that

wind currents of the type commonly encountered in warehouses would have little effect on insect movement.

When adults of the three species and *Tribolium castaneum* (Hbst.) were released on the centre bag of the top layer, counts a week later showed that their rate of movement through the stack depended on their normal speed of locomotion, as determined by measuring the distance travelled on a glass plate in five and ten seconds. Oviposition occurred in all layers of the stack, but more eggs were laid in the bags first entered and in those containing the moister grain.

As the insects that reached the bottom of the stacks showed no tendency to move outwards from them, it is concluded that insecticides for their control should be applied to each layer of the stack or at least to the bottom and top layers, instead of only to the outer surfaces, as is now done, and that external examination, as currently practised, does not give a correct picture of conditions inside the stack.

Pruthi (H. S.). **Critical Studies on Insecticides. I. Effect of Temperature on the Toxicity and comparative Efficacy of some modern anti-locust Insecticides.**—*Indian J. Ent.* **18** (1956) pt. 3 pp. 273–295, 34 refs. New Delhi, 1957.

BHC dusts and aldrin sprays have been used against *Schistocerca gregaria* (Forsk.) in India. Aldrin proved effective [*cf. R.A.E.*, A **44** 217, etc.], but the BHC dust was not satisfactory when applied against overwintering swarms. The insecticides were used at rates recommended in colder climates, and experiments were made in 1955 on the effect of temperatures varying from about 75 to 92°F. on their contact toxicity to adult males. When the insects were dusted with small known amounts of powder containing 7·5–10 per cent. BHC or 1 per cent. aldrin or dipped, all but the head, in wettable-powder suspensions of 1 per cent. γ BHC or emulsions containing 0·4–0·8 per cent. aldrin, examination for knockdown and mortality over about seven hours showed that the toxicity of both insecticides increased with the prevailing temperature. In the few cases in which there were marked changes in relative humidity, mortality was not proportional to temperature, which suggested that humidity might also be an important factor. In a comparison of insecticides, hoppers were dusted with 1 per cent. aldrin or dieldrin or 5 per cent. BHC over a similar range of temperatures. BHC tended to give the best knockdown and kill, and there was little difference between aldrin and dieldrin. When males were dipped, 0·4 per cent. γ BHC in emulsified solution gave more rapid knockdown and kill than 0·4 per cent. wettable γ BHC or aldrin, and 1 per cent. wettable γ BHC tended to be better than 0·5 per cent. wettable aldrin. In these tests, rate of knockdown and kill generally increased with temperature, but was sometimes affected by relative humidity. It is concluded from these results that smaller doses of insecticide than had hitherto been recommended should give adequate control of locusts in India.

Singh (Sardar) & Kalkat (G. S.). **Occurrence of the Paddy Root Weevil in the Punjab.**—*Indian J. Ent.* **18** (1956) pt. 3 pp. 302–303. New Delhi, 1957.

In the rice belt fed by a distributory of the Ghaggar Barrage in the Hissar district of the southern Punjab, severe damage to the crop, which was reported in one village in 1953 and subsequently spread to another, was found to be caused by *Echinocnemus oryzae* Mshl. The larvae of this

weevil devoured the fibrous roots of the plants, and damage was particularly noticeable on newly transplanted rice during July and August, infested fields showing large empty patches; established plants are less likely to wither as a result of the attack. The larvae pupate in the soil and give rise to adults in early July. In 1956, rice transplanted late, in the second or third week of August, escaped attack, and gave a fairly good yield in the first week of October, although the populations of larvae and adults were very high in July. It is stated in an editorial footnote that *E. oryzae* had hitherto been recorded only from one district in Madras [*R.A.E.*, A **42** 208], so that the present observations indicate a wider distribution of the pest in India.

Butani (D. K.). **A Key for the Identification of Sugarcane Borers.**—*Indian J. Ent.* **18** (1956) pt. 3 pp. 303–304, 3 refs. New Delhi, 1957.

The key given permits the larvae of Lepidoptera that bore in the stems of sugar-cane in India to be differentiated by means of characters readily observed in the field with the aid of a pocket lens.

Sengupta (G. C.) & Behura (B. K.). **Annotated List of Crop Pests in the State of Orissa.**—*Mem. ent. Soc. India* no. 5, [1+] 44 pp., 2 figs., 16 refs. New Delhi, 1957.

In this list, the pests, which are almost entirely insects, are arranged under the crops attacked, and notes varying in scope and detail are given on their bionomics, alternative food-plants or injuriousness. Recommendations for control by means of insecticides are appended. Among the pests recorded as new to India [*cf. R.A.E.*, A **45** 215], the only two of major importance are the Pyralids, *Noorda albizonalis* Hmps. and *Ctenomeristis ebriola* Meyr., the larvae of which bore in mango fruits.

Srivastava (A. S.). **Bionomics and Control of Singhara Beetle** (*Galerucella birmanica* **Jacoby—Chrysomelidae**) **in Uttar Pradesh.**—*Agric. Anim. Husb. Uttar Pradesh* **6** no. 7 pp. 5–10, 3 figs., 1 map. Lucknow, 1956.

Galerucella birmanica (Jac.), all stages of which are described, is an important pest of water-nut (*Trapa bispinosa*) in Uttar Pradesh. The habits of this Galerucid and the injury caused are described [*cf. R.A.E.*, A **42** 418], and it is stated that the females lay 30–100 eggs each on the leaves and that the egg, larval and pupal stages last 6–9, 10–13 and 7–10 days, respectively, depending on temperature. The life-cycle is completed in a month or less, and there are nine overlapping generations a year, the adults hibernating in crevices at the sides of the ponds from December or January until April. For control, dusting with 5 per cent. BHC at the rate of 25–30 lb. per acre is extremely effective, destroying both larvae and adults.

Donald (R. G.). **The natural Enemies of some Pseudococcidae in the Gold Coast.**—*J. W. Afr. Sci. Ass.* **2** no. 1 pp. 48–60, 11 refs. London, 1956.

In connection with the introduction of natural enemies for release against the mealybugs that transmit the swollen-shoot disease of cacao in Ghana [*cf. R.A.E.*, A **45** 310, etc.], a survey of the indigenous insects that attack mealybugs there was carried out between January 1950 and March 1953. A list is given showing the parasites, hyperparasites and predators found

[*cf.* also **45** 312], with notes on their hosts, frequency and distribution, and the relations of the mealybugs to the complexes of natural enemies attacking them are discussed. Most of the collecting was done from cacao, and as *Pseudococcus njalensis* Laing is by far the most numerous mealybug on this plant throughout the country [*cf.* **39** 303], it is the species dealt with in most detail. Its most important primary parasite was *Neodiscodes martinii* Comp., followed by *Anagyrus pullus* Comp. and a species of the same genus that may be *A. aurantifrons* Comp. Other species were much less common. Cecidomyiids were the most numerous predators of *P. njalensis*, all those identified being *Schizobremia coffeae* Barnes. They usually attacked the eggs and nymphs, and were less frequent in colonies attended by ants of genera that build protective tents than in unprotected colonies. The other predators were mostly Coccinellids, largely *Scymnus* spp. One such Coccinellid, *Platynaspis higginsi* Crotch, and the predacious larvae of a Lycaenid, *Aslauga vininga* (Hew.), were found only in ant-protected mealybug colonies.

McKinlay (K. S.). **Control of Cotton Pests in the Western Province, Tanganyika Territory.**—*Emp. Cott. Gr. Rev.* **34** no. 2 pp. 93–98. London, 1957.

Investigations were carried out in 1955–56 at Urambo to ascertain whether the use of insecticides would enable cotton to be grown profitably in the Western Province of Tanganyika under conditions of heavy attack by stainers. Cotton was sown in December 1955, and the first insects to attack the plants were termites, which destroyed many soon after growth had begun by entering below soil level and tunnelling up the stems. The damage was checked, though slowly, by spraying the plant bases with γ BHC at 4 oz. per acre, and subsidiary tests showed that it could be prevented by soil treatment with aldrin at 4 oz. per acre before sowing, by watering the soil at the base of each plant with emulsions affording 4 oz. aldrin, BHC or Hanane [bis(dimethylamino) fluorophosphine oxide (dimefox)] or 1 lb. DDT per acre, or injecting these liquids into the soil at a depth of 2 ins. Aldrin and DDT proved the most effective. Buds appeared in the third week in February, and damage by *Heliothis armigera* (Hb.) was severe from then until the end of March; after destroying all the buds on untreated plants, the larvae attacked the leaves. The Pentatomid stainer, *Calidea dregii* Germ., migrated to the crop in large numbers from the end of March to the end of May and proved difficult to control owing to its protracted appearance, great mobility and natural resistance to insecticides, a spray affording 1 lb. DDT per acre not effecting complete control 12 hours after contact with the insects. Some relief might be afforded by trap crops, for the adults migrated to neighbouring sorghum as soon as it began to produce seeds; when the sorghum was cut, they returned to the cotton. Other pests that attacked the crop were *Aphis gossypii* Glov., which tended to increase at the end of the season, after the rains, and *Earias* sp., which was not numerous.

Two plot experiments on control were carried out. In the first, sprays of 4 oz. endrin, DDT, BHC or dieldrin, 1 lb. DDT, 4 oz. DDT with 4 oz. BHC, and 1 lb. DDT with 4 oz. BHC in 12 gals. per acre were applied with knapsack equipment six times at weekly intervals from 21st February to 27th March against *H. armigera*. Because of increasing numbers of *C. dregii* from mid-March, all plots in four of the five blocks were sprayed with DDT at 1 lb. per acre on the 4th, 10th and 17th April for its control, and because of a threatened increase in *A. gossypii*, BHC at 4 oz. per acre was added to the DDT spray on 24th April and 8th May. The other block received no further treatment. The results showed that all insecticides but

BHC alone significantly reduced the numbers of buds damaged by *H. armigera*, 1 lb. DDT alone or with 4 oz. BHC being much the most effective, and that all blocks protected against *Calidea* produced much more seed cotton than those not so protected, DDT at 1 lb. permitting the highest yield in most cases. In the second experiment, 1 lb. DDT with 4 oz. BHC was applied in 3, 6, 12 or 24 gals. spray per acre 11 times between 25th February and 5th May. *Calidea* did not increase, and control of *H. armigera* was far better for 6–24 gals. spray per acre than for 3 gals. All treatments resulted in good yields, and the higher spray rates tended to increase them, though the differences were not significant. It is concluded that if insects are controlled by means of sprays, rainfall is sufficient and cultural methods adequate, yields of about 1,500 lb. seed cotton per acre can be expected.

Tunstall (J. P.). **The Biology of the Sudan Bollworm, *Diparopsis watersi* (Roths.), in the Gash Delta, Sudan.**—*Bull. ent. Res.* **49** pt. 1 pp. 1–23, 9 figs., 11 refs. London, 1958.

Diparopsis watersi (Roths.) is a serious pest of cotton in the area of the eastern Sudan known as the Gash Delta, but little is known of the history of its occurrence there. In this paper, the climate and method of cultivation practised in the area are described, and an account is given of observations on its bionomics carried out in 1951–55. The following is largely based on the author's summary of the results.

Most of the eggs were laid on the younger and more accessible plant growth. The period of wandering in search of food after hatching was usually short, and mortality from failure of the larvae to find suitable buds or bolls was low on healthy plants. Pupation usually occurred in the soil, at depths that did not vary greatly with soil type; most pupae were found within an inch of the soil surface and none at a depth greater than three inches. Some of the pupae enter diapause. The newly emerged moths had difficulty in passing through the soil to the surface only where it was a heavy clay that had hardened after the rains.

The proportion of larvae forming diapause pupae increased among field-collected larvae as the season advanced and in successive generations reared in an insectary from the non-diapause fractions of the preceding generations, but at no time was there a complete cessation in the production of non-diapause pupae, so that infestation persisted as long as the cotton was actively growing. The emergence of moths from diapause pupae was not completed during the season following that of pupation, but extended for at least two further seasons; some 35 per cent. of the total number of diapause pupae were still alive in the soil after the first season's emergence. In any one season, emergence was bimodal, the peaks, which were of similar magnitude, occurring in September–October and between mid-November and mid-January. When diapause pupae were kept in the laboratory, and thus exposed to less extreme temperatures than in the field, the emergence was distinctly unimodal, with a maximum during September. The bimodal emergence observed in the field is considered to be a result of external environmental factors that inhibit pupal development at certain times of year, and emergence data from diapause pupae exposed to different climatic conditions suggest that high soil temperatures are such a factor. The pattern of moth emergence from diapause pupae is compared with that found in Nyasaland [*cf. R.A.E.*, A **34** 332] and Nigeria [*cf.* **43** 6].

No natural enemies of the eggs were observed, but the larvae were attacked by several parasites, notably a species of *Apanteles* near *A. ultor* Reinh. and *Bracon brevicornis* Wesm., which parasitised younger and older larvae, respectively, and by predators, chiefly Neuroptera; the pupae were destroyed by ants.

It is concluded that the occurrence of a second period of emergence from diapause pupae renders it impossible to keep the population at a low level throughout the season by controlling the initial infestation, though this is of value in enabling early bolls to set. The use of insecticides would not be warranted for control of the early infestation, would be impracticable against that arising from the second peak of emergence, owing to the advanced state of plant growth, and might prove injurious to the natural enemies [*cf.* **44** 464]. Control measures would best be directed against the pupae, preferably when the cotton plants have been destroyed and no other stages are present, and in preliminary experiments during 1954–55, disk-ploughing to a depth of 8 ins. reduced the pupal population by 50 per cent.

Bradley (J. D.). **A new Species of Xyloryctid Moth bred from Coffee in East Africa.**—*Bull. ent. Res.* **49** pt. 1 pp. 25–26, 4 figs. London. 1958.

Odites semibrunnea, sp.n., is described from adult males reared from larvae found infesting coffee fruits in Kenya in 1956.

Slow (J. M.) (Mrs. J. M. Wells). **A morphological Comparison of the Adults of** *Oryzaephilus surinamensis* **(L.) and** *O. mercator* **(Fauv.) (Col., Cucujidae).**—*Bull. ent. Res.* **49** pt. 1 pp. 27–34, 8 figs., 6 refs. London, 1958.

A detailed account is given of studies showing that *Oryzaephilus mercator* (Fauv.) is distinct from *O. surinamensis* (L.). The results were cited in a paper already noticed [*R.A.E.*, A **44** 410].

Büttiker (W. W.) & Bünzli (G. H.). **Biological Notes on the Tobacco Cricket,** *Brachytrupes membranaceus* **(Dru.) (Orthopt., Gryllidae), in Southern Rhodesia.**—*Bull. ent. Res.* **49** pt. 1 pp. 49–57, 1 pl., 2 figs., 8 refs. London, 1958.

The following is based largely on the authors' summary. Observations in 1949–52 on the bionomics of *Brachytrupes membranaceus* (Dru.), which attacks young plants of tobacco, maize, and other field and garden crops in Southern Rhodesia [*cf. R.A.E.*, A **45** 399] showed that this Gryllid is widely distributed and most abundant on light sandy soils of granitic origin. It has one generation a year. The eggs are laid in February–March in the burrows of the females, which average 50–80 cm. in depth, and the average number found in 22 dissected females was 216. The nymphs hatch in about 30 days, disperse, and excavate fresh burrows. Development is at first rapid, but is retarded during June–October, when food is dry and often scarce, after which it becomes rapid again during November–May, when the nymphs are in the third and fourth (last) instars and young succulent plant growth is abundant. The adults first appear in early December and were present in the field until early March. Crop plants are damaged during November–December, when weeds have been removed or reduced to a minimum by cultivation.

The burrows and the method by which they are excavated are described. The entrances are concealed, and the soil removed forms a mound outside that may reach a height of 30 cm. by the time the adult stage is reached. Soil is periodically expelled, and the entrances are opened and closed, apparently in response to meteorological factors. Excessive moisture in the burrows causes the crickets to emerge from them, but there is no emergence during or after prolonged or heavy rains. On savannah land, the improved

aeration of the soil brought about by the construction of the burrows promotes the growth of deep-rooted, woody plants. The crickets feed on vegetation of many kinds. Plant material lying loose on the soil is preferred, and to this is attributed the successful control given by poison baits [*cf. loc. cit.*]. The food material is compacted in chambers in the burrows, but has not been found in a mouldy or fermenting state, and is therefore thought to be conditioned before storage, succulent materials being allowed to wilt and dry ones to be softened by dew.

Moutia (L. A.). **Contribution to the Study of some phytophagous Acarina and their Predators in Mauritius.**—*Bull. ent. Res.* **49** pt. 1 pp. 59–75, 9 refs. London, 1958.

Because of the recent increase in injury to crops, notably tomato, by Tetranychids in Mauritius [*cf. R.A.E.*, A **43** 386], a survey of the mites associated with plants there was carried out in 1952–56, a list is given of the 30 species found, of which 21 were phytophagous and the remainder mainly predacious, with notes on their feeding habits, natural enemies and importance and the results of studies on the bionomics of some of them and the main predators. The species of most importance as pests were *Tetranychus marianae* McG., which is destructive to tomato, egg-plant (*Solanum melongena*), potato and groundnut; an apparently undescribed species of the group of *T. ludeni* Zacher, which damages beans, *Hibiscus esculentus*, and cucurbits and is often associated with *T. marianae* on egg-plant; *Raoiella indica* Hirst, which appears to be of recent introduction and attacks coconut and other palms, including date; and *Hemitarsonemus latus* (Banks), an important pest of many vegetables, fruit trees and other plants. Other injurious species included *Eutetranychus banksi* (McG.), which is common on the leaves of *Citrus*, usually causing them to fall, and also occurs on other trees; *Oligonychus biharensis* (Hirst), which attacks several plants including mango, litchi, loquat (*Eriobotrya japonica*) and camphor (*Cinnamomum camphora*); *O. mangiferus* (Rahm. & Sapra), which attacks mango, loquat and peach; a species of the group of *Oligonychus pratensis* (Banks), on coconut and maize; *T. cucurbitae* Rahm. & Sapra, on peach; *Phyllocoptruta oleivora* (Ashm.), which is of potential importance on *Citrus* [*cf.* **44** 248], *Tegonotus* sp., on the leaves of tomato; and *Brevipalpus phoenicis* (Geijskes), which attacks many plants, and is sometimes injurious to the fruits of *Citrus* and the leaves of tea.

The bionomics of *T. marianae* and *R. indica* were investigated in the laboratory by a leaf-disk technique [**42** 102]. *T. marianae* is most injurious in dry districts, and its development was completed in means of 4–9 days in summer and 15–22 in winter. Males both completed their development and died a few days before the females, which survived for mean and maximum periods of 41·5 and 43 days, respectively. The females laid 105–146 eggs each over periods of 32–35 days; unfertilised eggs gave rise to males only. In the field, females were more abundant than males, especially during November–December. There were about 24–30 generations a year, of which an average of 17·5 occurred during November–April. High mortality was caused by heavy rain and gales. This species and *Tetranychus* sp. are attacked by predators [*cf.* **43** 387], of which the most important were the Coccinellid, *Stethorus vinsoni* Kapur, and a Cecidomyiid identified as *Feltiella* sp. near *tetranychi* Rübs. Neither increased in numbers sufficiently early to prevent damage, though other Tetranychids are sometimes checked by the Cecidomyiid. The development of *Stethorus* lasted 17 days in summer and 34 days in winter, and that of *Feltiella* 18 days in summer; females of *Stethorus* laid an average of 65·7 eggs each.

R. indica attacks coconut palms up to five years of age and older ones growing in poor conditions, and occurs in large numbers on the lower surfaces of the leaves, where the eggs occur in masses of 108–330. Development was completed in 18–26 days in February–March and 30–36 in July–August. The females, which are sometimes fertilised in the deutonymphal stage, laid average and maximum numbers of 28·1 and 38 eggs, respectively; the average survival period of the females was 27 days, and that of males 3–5 days less. Females were more numerous than males, especially in April–May. *R. indica* is generally abundant in September–March, unless heavy rain decreases the population. The eggs are destroyed by nymphs and adults of *Typhlodromus caudatus* (Berl.), adult females of which consumed up to 16·9 per day. The adults of *Typhlodromus* survived for up to 63 days with food and eight without. Numbers were lowest (5·2 per leaflet) in August and highest in September–March, with a peak (20·9 per leaflet) in October. Two generations were produced per month in winter and 4–5 in summer. In the laboratory, adults survived for 25–30 days, and the females laid an average of 50 eggs over a period of 15 days.

The factors responsible for the increase in the infestation of tomato are briefly discussed. The most important appear to be the absence of severe storms since 1945, the increased use of nitro-phosphatic fertilisers [*cf.* **40** 386], the numerous wild food-plants of the mites, and the ineffectiveness of *S. vinsoni* as a predator, which is specially marked on this crop.

Long (D. B.). **Field Observations on Adults of the Wheat Bulb Fly (*Leptohylemyia coarctata* (Fall.)).**—*Bull. ent. Res.* **49** pt. 1 pp. 77–94, 16 figs., 6 refs. London, 1958.

The following is based almost entirely on the author's summary. A study of adult populations of *Hylemyia* (*Leptohylemyia*) *coarctata* (Fall.) was carried out by routine sweeping in a field under continuous winter wheat at Rothamsted [*cf.* also next abstract]. Males emerged slightly before females, and it was found that the emergence period may cover at least three weeks in late June and early July. Although the males were at first more numerous than the females, the latter predominated later, owing to the shorter life of the males [*cf. R.A.E.*, A **34** 368]. The numbers of flies on the wheat fluctuated appreciably. During the first week of the emergence period, the number taken increased steadily throughout the day. After the population had reached its peak, however, the maximum numbers occurred in the very early morning and the late evening, which suggested a daily flight dispersion followed by a general or localised return. The daily temperature rhythm was only partly responsible for the dispersion, and there appeared to be an active return flight to the crop in the evening. The males were generally more active than the females and did not settle so deeply in the crop [*cf.* next abstract but one].

The temperature threshold for flight was 12–13°C. [53·6–55·4°F.]. Winds up to eight miles per hour did not appear to affect flight activity, but higher winds (15 m.p.h.) markedly reduced it, the flies remaining deep in the crop, near ground level. Gale-force winds caused a permanent reduction in the number of adults in the field, indicating that the population was probably localised.

Although portions of the population dispersed fairly rapidly from the emergence sites, recaptures of adults labelled with ^{32}P and released indicated that the extent of the dispersion was not very great. The females dispersed more than the males and were influenced to some extent by the occurrence of wheat in flower. The flies frequently congregated on the lee edge of the crop, but other preferred regions were observed that could not be attributed to the influence of wind.

Dobson (R. M.), Stephenson (J. W.) & Lofty (J. R.). **A quantitative Study of a Population of Wheat Bulb Fly, *Leptohylemyia coarctata* (Fall.), in the Field.**—*Bull. ent. Res.* **49** pt. 1 pp. 95–111, 1 pl., 6 graphs, 11 refs. London, 1958.

The following is based almost entirely on the authors' summary. A quantitative study of a field population of *Hylemyia* (*Leptohylemyia*) *coarctata* (Fall.), consisting principally of observations on the adults [*cf.* also preceding abstract] but supplemented by some on the immature stages [*cf.* also next abstract], was carried out at Rothamsted in 1956. Emergence was investigated by the use of a cage of fine terylene netting 24ft. long, 12 ft. wide, and 6 ft. high, which was erected in an infested wheat field shortly before adults were expected to appear and was searched twice daily, at 10 a.m. and shortly before sunset. The cage and the climate within it are described in an appendix. In all, 293 males, of which 186 appeared between 1st and 6th July, were caught during the 26 days from 24th June to 19th July and 258 females, of which about half emerged between 6th and 10th July, during the 35 days between 21st June and 25th July. The highest daily catch of males was 40 on 6th July, by which date about 84 per cent. of the total had emerged, and that of females was 37 on 8th July, when 66 per cent. of the total had emerged. Population decrease was investigated by marking (with artist's oil colours) newly emerged flies caught in the cage with a colour or combination of colours that was changed daily, releasing the marked flies in the cage, and recording the numbers found, with their marks and sex, every three days thereafter. Mortality during the first day was very high (38 and 36 per cent. for males and females, respectively), but the numbers subsequently decreased at a steady rate. This high initial mortality is believed to have been due to the marking, but the length of life of flies that survived was not impaired, and the rate of population decrease was therefore estimated from the recapture figures alone. The half-life of male and female populations was estimated as 7·3 and 11·1 days, respectively. Application of the estimated rate of population decrease to the observed emergence figures enabled a general picture of the size and structure of the population to be obtained. Males were twice as numerous as females until 6th July and predominated until 8th July, but they were less long-lived and represented only a quarter of the total population by the first week in August.

Observations on the populations of the various stages that developed in the cage showed that mortality between pupation and emergence of adults was high (78 per cent.) and that the egg population in the autumn of 1956 was only about one-seventh of that of the previous year. This reduction was not observed outside the cage and may have been due to an effect of experimental conditions on the survival rate and fecundity of the adults.

Long (D. B.). **Observations on the Occurrence of larval Infestations of Wheat Bulb Fly, *Leptohylemyia coarctata* (Fall.).**—*Bull. ent. Res.* **49** pt. 1 pp. 113–122, 1 pl., 4 figs., 8 refs. London, 1958.

The following is based mainly on the author's summary. The effect of the previous crop on the subsequent infestation of winter wheat by *Hylemyia* (*Leptohylemyia*) *coarctata* (Fall.) was investigated in 1954–56, mainly on clay loam soil at Rothamsted. By far the highest larval populations followed fallows, the next highest followed potatoes, which are a low, open cover crop, whilst much lower populations followed the tall crops of beans and wheat, and very small infestations followed grass mat covers. This confirms previous results obtained under different agricultural conditions [*cf. R.A.E.*, A **34** 367]. Preceding applications of dung and straw increased infestation

following fallow in dry summers but not in a wet year. The effects of other manurial treatments were doubtful. Wheat was shown to influence the flight path of the flies and to interfere with local egg-laying behaviour, producing a horizontal effect extending for a distance equal to up to twice its own height; this effect was greatest when the stand was situated on the south-west border of an adjacent fallow and thus presented the greatest contrasts of light and shade. Apart from the foregoing factors, the differences in the level of infestation that were observed at Rothamsted, where the wheat fields are well separated, could be explained by close proximity or otherwise to a centre of heavy infestation.

Contact with the soil appears to be of importance in stimulating oviposition, and females alighting on wheat ran down the stems for a distance of only about 18 ins. before returning, and flying away; this behaviour would materially reduce oviposition by preventing contact with the soil. Beet permitted easy access to the soil, but a grass mat cover provided an effective barrier, and wheat following mustard grown to provide a dwarf, dense ground cover appeared to be completely uninfested. Analysis of the distribution of the few larvae present in wheat following wheat and of larvae in wheat following fallow showed that it was random in both cases and that the parent females laid only one or a few eggs on each occasion [*cf.* **34** 368].

Bhambhani (H. J.) & Blackith (R. E.). **Responses of Pests to Fumigation. VII. The Relation between Fumigation Techniques, Mortality, and the Amount of Hydrogen Cyanide sorbed by** *Calandra* **spp.**—*Bull. ent. Res.* **49** pt. 1 pp. 165–175, 7 graphs, 18 refs. London, 1958.

The following is virtually the authors' summary of this paper, which is one of a series [*cf. R.A.E.*, A **45** 62, etc.]. The relation between fumigation techniques, mortality and sorption of fumigant was investigated by two factorial experiments in which adults of *Calandra granaria* (L.) and *C. oryzae* (L.) were exposed to hydrogen cyanide at concentrations of 12, 26 or 44 mg. per litre and pressures of 2, 27, 52 and 76 cm. mercury for 30, 60 or 90 minutes, or at given concentration-time products (36, 72 or 108 mg. hours per litre), in each of which the time component was 1, 4 or 12 hours, and pressures of 2, 37 and 76 cm. mercury. The methods of fumigation and estimation of sorption and mortality were those used in earlier investigations [*cf.* **44** 307; **45** 62], and the results are shown in a series of graphs.

For both species, sorption of HCN increased as the total pressure was reduced, about three times as much being sorbed, in the first experiment, at a pressure of 2 cm. as at atmospheric pressure, the increase in sorptive capacity being greater in the case of *C. oryzae* than in that of *C. granaria*. In the second experiment, sorption by both species, for a given concentration-time product, was greater at a high concentration applied for a short period (one hour) than at a lower concentration applied for a long period (12 hours); in the former conditions, *C. granaria* consistently sorbed more fumigant than did *C. oryzae*; in the latter, the reverse was the case, and in intermediate conditions (four hours' exposure), the amounts sorbed by the two species did not differ materially. This result was inconsistent with that of the first experiment, in which *C. oryzae* sorbed more than did *C. granaria* during short exposures (30–90 minutes).

These effects on sorptive capacity of differing conditions of fumigation could account for most of the reported departures from the rule that the biological effects of fumigation can be described by the product of the mean concentration of fumigant applied and the period of exposure [*cf.* **41** 313; **42** 40]. Comparison between mortality and sorption at pressures of 27–76 cm. in the first experiment showed, however, that while these were broadly associated, the increased mortality at higher concentrations was greater than

would be expected from the associated increase in sorption, and this discrepancy was significantly larger for *C. oryzae* than for *C. granaria*.

Lloyd (C. J.) & Hewlett (P. S.). **The relative Susceptibility to Pyrethrum in Oil of Coleoptera and Lepidoptera infesting Stored Products.**—*Bull. ent. Res.* **49** pt. 1 pp. 177–185, 1 graph, 12 refs. London, 1958.

The stored-product pests used in the tests described comprised adults of four species of moths and 27 beetles, larvae of all the moths and 12 of the beetles, and larvae of a further beetle species. Pyrethrins were used at 1·3 per cent. (w/v) alone and at 0·3 per cent. (w/v) with 3 per cent. (v/v) piperonyl butoxide in a heavy, highly refined mineral oil (Shell Risella 17) and were applied, where possible, by techniques previously described [*R.A.E.*, A **32** 182; **37** 231], as direct sprays or as deposit films on filter paper on which the insects were subsequently confined. The deposits (in mg. oil solution per sq. cm.) were 1·7–2·5 for films and 0·3–1 for the direct sprays. While confined on films and after being sprayed, the insects were kept at 25°C. [77°F.] and 70 per cent. relative humidity.

Counts were made after 1–9 days, and the insects were then classified according to their susceptibility. The six classes adopted ranged from very susceptible to very resistant, for which the mean mortality percentages after six days, based on the combined results for both methods of treatment, were 98 and 1, respectively. A list of the insects in the various classes is given; adults of *Sitotroga cerealella* (Ol.), *Ephestia elutella* (Hb.), *E. cautella* (Wlk.), *Acanthoscelides obtectus* (Say), *Callosobruchus chinensis* (L.), *Latheticus oryzae* Waterh., *Necrobia rufipes* (Deg.) and *Calandra granaria* (L.) proved very susceptible, and adults of *Tribolium destructor* Uytt. and *Dermestes lardarius* L. and larvae of *D. lardarius* and *Tenebroides mauritanicus* (L.) very resistant. Except for adult Bruchids and moths, which were all susceptible or very susceptible, and adult Ptinids, which were at least moderately resistant, susceptibility showed little or no correlation with systematic position [*cf.* **41** 443]. The larva of any species was usually more resistant than the adult, and pupae that were formed on the films appeared to be at least as resistant as the larvae from which they were derived.

Among adults of different species, susceptibility to pyrethrins appeared to be correlated with a normal high level of activity. For most of the insects, the mortality from the sprays and the film deposits was about equal, and for most of the others, and especially for adults of *Alphitobius laevigatus* (F.), *Ptinus tectus* Boield., and *Niptus hololeucus* (Fald.), the sprays were the more toxic; films were more toxic than sprays to adults of *Gnathocerus cornutus* (F.). In general, the toxicity of the pyrethrins applied alone or in combination with piperonyl butoxide was about equal [*cf.* **40** 1], but pyrethrins alone were conspicuously more toxic to adults of *Gibbium psylloides* (Czenp.) and larvae of *Tenebrio obscurus* F., *T. molitor* L., *E. cautella* and *Anagasta kühniella* (Zell.) when applied as a film and to adults of *Tribolium castaneum* (Hbst.), *G. psylloides* and *Tenebrio molitor* and larvae of *Tribolium destructor* when applied as a spray. Synergised pyrethrins were the more toxic to adults of *Mezium affine* Boield. and *C. oryzae* (L.) in films and to those of *C. oryzae* in sprays. Mortality among adults of *T. destructor*, *T. confusum* Duv. and *Gnathocerus cornutus* and larvae of *Tenebroides mauritanicus* and *D. lardarius* exposed to films was low, but 78–83 per cent. of the survivors remained paralysed throughout the nine days of observation; unpublished work by Hewlett showed that although mortality among *Tribolium castaneum* exposed to a pyrethrins film for four days exceeded 50 per cent., a high proportion of the paralysed survivors recovered

if taken from the film. Both *T. destructor* and *Ephestia elutella* can lay viable eggs when paralysed.

Adults of 11 species and larvae of one of them and three others were used in the tests with oil alone, in which the deposits were 2 and 2·5 mg. per sq. cm. for films and 0·35 and 1 for sprays. Adults of *S. cerealella*, *E. cautella* and *E. elutella* proved very susceptible, with a mean mortality after six days of 95 per cent., and adults of *Oryzaephilus surinamensis* (L.), *C. oryzae*, *P. tectus*, *Stegobium paniceum* (L.), *Trogoderma versicolor* (Creutz.) and *G. cornutus* and larvae of *O. surinamensis* and *Tribolium castaneum* were the most resistant, with a mean mortality of 14 per cent.

Martin (E. L.). **Notes on some Rice Stem Borers (Lepidoptera: Pyralidae), with the Description of a new Species of *Chilo* Zincken.**—*Bull. ent. Res.* **49** pt. 1 pp. 187–191, 1 pl., 8 figs., 15 refs. London, 1958.

This paper was written to clarify the nomenclature of certain Pyralid stem borers of rice. The new species, which is described from adults of both sexes reared from rice in Southern Rhodesia in 1955, is *Chilo phaeosema*, and it is recorded also from Tanganyika and Nyasaland. Specimens of it in the British Museum were identified by Hampson as *Diatraea africana* Auriv., although they do not agree well with the original description and figure of the latter. The author examined the type specimens of *D. africana* and concludes that *Parerupa diagonalis* Hmps. is a synonym of it; *D. africana* [which has been considered by some referable to the genus *Proceras* (*cf. R.A.E.*, A **46** 29, 30)] is transferred to *Parerupa*, and a specimen from Lower Meru is selected as lectotype from the six females from which the species was originally described.

The other species considered are *Maliarpha separatella* Rag., which is represented in the British Museum by specimens from Ghana, the Cameroons, Nyasaland, Madagascar, Burma and China and has been bred from rice in Ghana, Senegal and Swaziland, *Schoenobius incertulas* (Wlk.), and *Scirpophaga chrysorrhoa* Zell., which has not been recorded from rice but occurs in various countries in the Oriental region and also in northern Australia and may have been confused with *Schoenobius incertulas*. The synonymy of these three species is discussed, and notes are given on their morphology. *M. separatella* is the type of its genus, and as *Ampycodes pallidicosta* (Hmps.) [*cf.* **44** 27], the type of *Ampycodes*, is identical with it, *Ampycodes* is a synonym of *Maliarpha*. The male and female genitalia of *M. separatella*, *C. phaeosema*, *S. incertulas* and *Scirpophaga chrysorrhoa* are figured.

Bull (J. O.) & Solomon (M. E.). **The Yield of *Lasioderma serricorne* (F.) (Col., Anobiidae) from a given Quantity of Foodstuff.**—*Bull. ent. Res.* **49** pt. 1 pp. 193–200, 8 refs. London, 1958.

The following is virtually the authors' summary. An experiment was designed to ascertain the maximum yield of adults of *Lasioderma serricorne* (F.) that could be reared from a given quantity of foodstuff. Equal numbers of eggs of this species were added to batches of tubes containing different weights of wheatfeed, and the resulting adults were removed, counted and weighed. The weights of wheatfeed were chosen so that in some of the batches of tubes it would not be completely exploited. When emergence of adults was complete, further numbers of eggs, which were calculated to produce approximately the number of larvae necessary to complete the process in each batch of tubes, were then added, and the resulting adults again removed, counted and weighed. The maximum biomass (wet weight)

of adults of *L. serricorne* that could be reared from egg to adult per gramme of wheatfeed at 25°C. [77°F.] and 70 per cent. relative humidity was found to be 0·214 g. (108–129 specimens, all more or less undersized, and many with a retarded rate of development, compared with insects given ample food). In addition to the 21 per cent. of the food converted into adult insects, another 27 per cent. by weight of the original foodstuff was lost, presumably as water and carbon dioxide, leaving just over 50 per cent. undigested residue, most of which was faecal matter that would have passed through the insects at least once. The yield of insects per g. loss of weight of the foodstuff was 0·46 g. (wet weights), which is very close to the corresponding figures calculated from the results of Fraenkel & Blewett for *Dermestes maculatus* Deg., *Tribolium confusum* Duv. and *Anagasta* (*Ephestia*) *kühniella* (Zell.) on various foods [*R.A.E.*, A **32** 417], but three times as great as the corresponding figure calculated from Richards' results for *Calandra granaria* (L.) in wheat [**37** 323]. There was evidence suggesting that a truly maximal yield (slightly greater than in these experiments) might be attained by adding an optimal number of eggs to the food at the start, instead of adding a second population to an incompletely exploited food supply.

Swenson (K. G.) & Tunnock (A.). **Beetles infesting stored Grain in the Willamette Valley of Oregon.**—*J. econ. Ent.* **50** no. 2 pp. 117–118, 6 refs. Menasha, Wis., 1957.

Since little is known of the insects that infest stored grain in the Willamette Valley of Oregon, a survey was made from autumn to spring over a two-year period. The valley has a marine climate, and the moisture content of wheat grown there is 11 per cent. or less at harvest, except in occasional wet seasons. Bins containing wheat, oats, barley or, occasionally, shelled maize were sampled and 15 species of Coleoptera were found infesting the grain in 89 of them. *Oryzaephilus surinamensis* (L.) was the commonest, occurring in 70 bins, followed by *Tribolium castaneum* (Hbst.), *Cryptolestes* (*Laemophloeus*) spp., *Calandra* (*Sitophilus*) *granaria* (L.) and *C.* (*S.*) *oryzae* (L.), which were found in 35, 35, 29 and 26, respectively; all exceeded 1,000 per U.S. gal. grain in at least one bin and the combined numbers of the first three exceeded 6,000 and those of the last two reached 2,800 in some. *Ahasverus advena* (Waltl) and *Typhaea stercorea* (L.) occurred, mainly in small numbers, in 17 and 13 bins, respectively, and other beetles in not more than four. Few moths were found, *Anagasta kühniella* (Zell.) occurring in one bin, *Plodia interpunctella* (Hb.) in three and *Endrosis lactella* (Schiff.) in one. Samples taken to a depth of 18 ft. revealed no species that did not occur at the surface; the numbers of insects decreased sharply with increasing depth, and there was no indication that the species occurred in markedly different proportions at different depths. Infestations did not die out during the winter.

Tanada (Y.) & Beardsley (J. W.). **Probable Origin and Dissemination of a Polyhedrosis Virus of an Armyworm in Hawaii.**—*J. econ. Ent.* **50** no. 2 pp. 118–120, 1 fig., 15 refs. Menasha, Wis., 1957.

Spodoptera mauritia (Boisd.), which was first observed on Oahu in December 1953 and injured lawns in Honolulu in 1954, was found to be infected with a polyhedrosis virus in February 1956. A survey made in the next two months revealed infected larvae in 11 populations in lawns in four districts. Attempts to transmit the virus of *S. mauritia* to *Pseudaletia unipuncta* (Haw.) and the virus of the latter [*cf. R.A.E.*, A **45** 96] to the

former were unsuccessful, but it is not yet known whether the virus of *S. mauritia* is specific to that insect. It seems likely that *S. mauritia* was introduced by aeroplane in the egg stage and carried the virus with it, as dissemination of the virus by the adult females through the eggs appears to be the most probable method of disease distribution.

Harries (F. H.) & Valcarce (A. C.). **Laboratory Toxicity Tests against Insects affecting Sugar Beets grown for Seed.**—*J. econ. Ent.* **50** no. 2 pp. 120–122, 1 ref. Menasha, Wis., 1957.

In the Salt River Valley of Arizona, where sugar-beet is sown in August–September and the seed harvested in the following July–August, *Circulifer tenellus* (Baker), the vector of the curly-top virus, is an important pest of the crop in the autumn and *Lygus hesperus* Knight, which reduces seed viability and yield, in late April and May. In tests of insecticides against these insects in 1954–55, small beet plants in pots were dusted by a vacuum method [*R.A.E.*, A **37** 471] and infested with ten field-collected adults. Mortality records 48 hours after infestation with *C. tenellus* showed that, immediately after application, 2 per cent. parathion, 5 per cent. Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] or malathion and 4 per cent. diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], which gave 97, 88, 72 and 71 per cent. mortality, respectively, were significantly more effective than 5 per cent. DDT or 2 per cent. dieldrin (57 and 50 per cent. kill), and that all these materials were superior to chlordane, endrin, toxaphene, heptachlor, BHC, Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of about 66 per cent.] and Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)], which showed little toxicity; a week after application, only dieldrin, chlordane, DDT, malathion and Chlorthion afforded appreciable control. Against *Lygus* adults, which were caged for 24 hours on the dusted plants, 5 per cent. malathion or Chlorthion and 2 per cent. parathion, dieldrin or endrin were highly effective immediately after application and the other materials gave significant control; in a further test, all but parathion were completely ineffective after a week.

The systemic insecticides, demeton [diethyl 2-(ethylthio)ethyl phosphorothioate], schradan, Thimet (Am. Cyanamid 3911 [O,O-diethyl S-ethylthiomethyl phosphorodithioate]) and Am. Cyanamid 12008 [O,O-diethyl S-isopropylthiomethyl phosphorodithioate], applied to the soil of the pots in 1 per cent. solutions of emulsions and watered in showed considerable toxicity to *C. tenellus* for more than two months and were more effective at 16 than at 8 lb. per acre; the last two were significantly more and schradan significantly less toxic than demeton. When tested against *Lygus*, the phosphorodithioates at 4 lb. per acre increased in toxicity during the week after application and remained toxic for at least 35 days. Liquid applications of 16 lb. of these two materials per acre caused some plant damage, and coating the seeds with preparations of them on activated carbon caused considerable stunting and leaf-curl of young plants, though the symptoms later disappeared. Soaking the seed for 30 minutes in 1 per cent. solutions of demeton or schradan or emulsions of Thimet or Am. Cyanamid 12008 had no adverse effect on germination and did not injure the plants.

Brazzel (J. R.) & Martin (D. F.). **Oviposition Sites of the Pink Bollworm on the Cotton Plant.**—*J. econ. Ent.* **50** no. 2 pp. 122–124, 1 graph, 5 refs. Menasha, Wis., 1957.

Field-cage experiments were carried out in Texas in 1955 to determine the preferred oviposition sites of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.)

on cotton plants as they developed from the four-leaf stage to maturity. Bolls appeared on the plants about 18th June, but they were not numerous until after 13th July. Before that date, more than half the eggs were laid on the terminals, and after it, one-third or more were deposited on the bolls; hardly any eggs were laid on the squares. The proportion laid on fruiting parts did not exceed that on vegetative parts until 2nd August, when the bolls were beginning to open.

Larvae from eggs deposited on the vegetative parts early in the season have to migrate over the plant in search of food and are therefore more exposed to destruction by predators, parasites or insecticides; this may explain the slow increase in population early in the season and the rapid increase later. Although all the moths liberated in the cage were obtained from overwintered larvae, the rate of oviposition appeared to increase as the season progressed, possibly because eggs were laid off the plants before the bolls appeared.

Randolph (N. M.). **Control of the Spotted Alfalfa Aphid on Alfalfa.**—*J. econ. Ent.* **50** no. 2 pp. 124–126, 3 refs. Menasha, Wis., 1957.

The spotted alfalfa Aphid [*Myzocallis maculata* (Buckt.)], here referred to as *Pterocallidium* sp., appeared on lucerne near College Station, Texas, in January 1955 [*cf. R.A.E.*, A **45** 11] and tests on its control were carried out in that and the following year. In sprays applied on 1st February 1955, 0·33 lb. malathion, 0·25 lb. parathion, 0·4 lb. γ BHC, 3 lb. of a 2:1 mixture of toxaphene and DDT, and 1·5 lb. DDT per acre gave good mortality, but infestation was heavier in 1956 and the Aphid more difficult to control. In tests in that year, 0·5–1 lb. malathion, 0·25 lb. parathion or demeton [diethyl 2-(ethylthio)ethyl phosphorothioate], 3 lb. of the mixture and 1 lb. DDT per acre in sprays applied in March or April generally gave good control for up to two weeks; 0·65 lb. Thimet (Am. Cyanamid 3911 [O,O-diethyl S-ethylthiomethyl phosphorodithioate]) in granules and 0·3 lb. endrin in a spray gave good immediate control, but showed no greater residual effect than the other materials, and 0·25 lb. endrin in granules was useless, apparently because it killed predacious insects.

Ball (H. J.). **On the Biology and Egg-laying Habits of the Western Corn Rootworm.**—*J. econ. Ent.* **50** no. 2 pp. 126–128, 5 refs. Menasha, Wis., 1957.

Diabrotica virgifera Lec. was recognised as a pest of maize for the first time in Colorado in 1909. It had spread across Nebraska to within 70 miles of the Missouri River by 1948 [*cf. R.A.E.*, A **35** 362], and was collected all along the river from South Dakota to Missouri in 1954. Observations on the bionomics of the Galerucid were made near Lincoln, Nebraska, in 1953–55 [*cf. loc. cit.*]. In field cages, 23 per cent. of the eggs were deposited in the top two inches of soil, 58 per cent. in the top four inches and 80 per cent. in the top six inches. The adults were present from very early July to October and lived for 16–84 days. They fed on the aerial parts of the maize plants [*cf.* **42** 290], including the kernels at the top of the ears towards the end of the season, at which time small numbers attacked the flowers of lucerne and *Kochia scoparia*. In the insectary, oviposition was rare when the evening temperature, or the minimum temperature for the day, was below 50°F., and commonest when the evening temperature was 60–65°F.; there was a general tendency for oviposition to increase with mean temperature,

and the average number of eggs per female for females that oviposited was 372 in 1954 and 418 in 1955.

Wilcox (J.) & Howland (A. F.). **Experiments for the Control of Spider Mites on Lima Beans.**—*J. econ. Ent.* **50** no. 2 pp. 128–132, 2 refs. Menasha, Wis., 1957.

Tetranychus telarius (L.) and to a less extent *T. ludeni* Zacher (*deviatarsus* (McG.)) are important pests of lima beans in southern California. Sulphur dust, which had for several years been used against them, gave inadequate control in 1951, and experiments to find more effective materials were carried out in 1952–55.

Acaricides were compared against *T. telarius* in seven tests, treatments being applied twice, in June–July, in 1952–54 and once, in July or August, in 1955, and the results are shown in detail in tables. Amounts of acaricide given are the totals applied per acre. Good control was afforded by demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] at 0·2–1·6 lb., Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] at about 1–2 lb., FW-293 [1,1-bis(p-chlorophenyl)-2,2,2-trichloroethanol] at 1·5–3·3 lb., ovex [p-chlorophenyl p-chlorobenzenesulphonate] at 3–6 lb., AC-528 (2,3-p-dioxandithiol S,S-bis(O,O-diethyl phosphorodithioate)) at 0·9–1 lb., Am. Cyanamid 12008 [O,O-diethyl S-isopropylthiomethyl phosphorodithioate] or Thimet (Am. Cyanamid 3911 [O,O-diethyl S-ethylthiomethyl phosphorodithioate]) at 0·5 lb., FW-152 [1,1-bis(p-chlorophenyl)-2,2-dichloroethanol] at 2 lb. and Stauffer R-1303 (O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate [Trithion]) at 0·3–0·5 lb. The first five of these materials were applied in dusts and sprays, and the remainder in sprays only. Parathion, malathion, Chlorobenzilate [ethyl 4,4′-dichlorobenzilate] and bis(p-chlorophenyl)-ethynylcarbinol in dusts and Dow ET-15 [O-methyl O-2,4,5-trichlorophenyl phosphoramidothioate] in dust and spray tended to be less effective. In single tests, Holcomb 326 [O,O-diisopropyl N,N-diethylthiocarbamyl phosphorodithioate] and p-chlorophenyl benzenesulphonate in sprays and NPD [tetra-n-propyl dithionopyrophosphate] and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] in dusts gave some control, and DN-289 (triethanolamine salt of dinitrobutylphenol) and Metacide [methyl-parathion and parathion] in dusts gave none. No control was obtained with one or two applications of dusting sulphur.

In tests in 1954 on number of applications, 3 per cent. Aramite dust applied at about 40 lb. per acre once on 28th May or 11th or 25th June or two or three times on these dates gave more than 94 per cent. reduction of *T. telarius* and significant increases in yield, with no significant differences except that a single application on the last date gave a lower yield than any but a single application on 11th June. Applications at about 30 lb. per acre on 14th or 28th July or both gave complete control, but only treatment on the first date increased the yield significantly. In these tests, 10 per cent. ovex dust tended to be inferior to Aramite and caused some crop reduction when applied on the later dates. Counts in July–August 1952 showed that damage by *T. telarius* decreased progressively from the edge towards the centre of a field for a distance of 190 ft., beyond which no measurable injury occurred, indicating that treatment might well be confined to the margins, which would result in substantial savings to the grower. Demeton residues were present in whole plants 28 days after treatment at about 3–16 oz. per acre on 6th July 1954, but not in the beans or pods 14–28 days after treatment with 3–13 oz. on 3rd August.

In tests in 1953–55 against *T. ludeni*, good results were given by one or

two applications of about 0·3–0·4 lb. demeton or 0·25 lb. Holcomb 326 in sprays, 1·5 lb. FW-293 or 0·9 lb. Aramite in dusts, or 31 lb. sulphur dust per acre. Other materials were less effective, and dusts of ovex or malathion useless. Demeton, FW-293 and Aramite were thus the only materials that controlled both species satisfactorily.

Dobson (R. C.) & Watts (J. G.). **Spotted Alfalfa Aphid Occurrence on seedling Alfalfa as influenced by systemic Insecticides and Varieties.** —*J. econ. Ent.* **50** no. 2 pp. 132–135, 1 graph. Menasha, Wis., 1957.

The spotted alfalfa Aphid [*Myzocallis maculata* (Buckt.)], here termed *Ptcrocallidium* sp., has been an important pest of seedling lucerne in New Mexico since 1954 [*cf. R.A.E.*, A **45** 11] and is difficult to control by means of conventional dusting or spraying machines. The use of systemic insecticides, applied to the soil or the seed before sowing at rates affording 1 lb. toxicant per acre, was therefore investigated in 1956.

In the first experiment, seeds of 12 varieties of lucerne were sprayed with an adhesive and dusted with Thimet [O,O-diethyl S-ethylthiomethyl phosphorodithioate], or Thimet in granules was applied in the furrow immediately before sowing. The seeds were sown on 17th March, and examination of the plants 39 days later showed that both treatments had reduced the stand slightly, though the reduction was significant only for the granules. Aphid populations were later in increasing and not affected by the insecticide, but they were lower on five varieties of lucerne than on the standard one. In the second test, Thimet, Bayer 19639 [O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate] and Bayer 23129 (O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate) were applied in granules as before and seed of six varieties sown on 27th September. Examination 28 days later showed that Thimet damaged the plants rather severely and Bayer 23129 considerably, whereas Bayer 19639 caused little or no injury. Untreated plants were killed or badly injured by the Aphid, so that the insect population was not maintained, and there were averages of 187·8, 178·8 and 25·7 Aphids per sample foot of row after treatment with Thimet, Bayer 23129 and Bayer 19639, respectively. In a greenhouse test, application of the insecticides at 4 lb. per acre in granules caused significant reductions in stand, though only those due to Thimet were likely to prove important.

English (L. L.) & Snetsinger (R.). **The Habits and Control of the Clover Mite in Dwellings.**—*J. econ. Ent.* **50** no. 2 pp. 135–141, 5 figs., 5 refs. Menasha, Wis., 1957.

The form of *Bryobia praetiosa* Koch that feeds on grasses, clovers and lawn weeds and migrates to the bases of trees or walls to moult, oviposit and overwinter [*cf. R.A.E.*, A **44** 320], sometimes constitutes a nuisance in Illinois, particularly on new housing estates, by entering dwellings in large numbers. Observation there showed that the optimum conditions for egg development and hatching are temperatures of 45–65°F. combined with high humidity. No eggs hatched at 32°F., and though development was accelerated at temperatures above 65°F., the percentage of eggs that hatched decreased progressively until all became dormant at 85°F. and remained so until lower temperatures returned. Climatic conditions are therefore most favourable in spring and autumn, and few mites occur round buildings in summer. All stages are present in crevices during the winter.

As the mite was found to exhibit the same sort of behaviour at the base of elm trees in lawns as at the foundations of buildings, such trees were used for comparison of the value of grass-free barriers and of acaricides for control

of the mite. Grass-free barriers round the trees greatly reduced the mite population at the bases of the trunks, a band 6 ins. wide halving the number of mites and the degree of control increasing as the band was widened to 12 and 24 ins. Clipping the grass round the trees was of no value. An 18-inch band proved as effective as two applications of 8 lb. 15 per cent. wettable Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], 25 per cent. wettable Chlorobenzilate [ethyl 4,4′-dichlorobenzilate] or 50 per cent. wettable Ovotran [p-chlorophenyl p-chlorobenzenesulphonate] per 100 U.S. gals. The grass-free barrier had a more lasting effect than the acaricides, but gave the quickest and most nearly complete control when supplemented by spraying. Similar results were obtained when the grass was removed from about the foundations of houses.

Stone (M. W.) & Foley (F. B.). **Control of Soil Insects on Turnips.**—*J. econ. Ent.* **50** no. 2 pp. 143–145, 4 figs., 3 refs. Menasha, Wis., 1957.

In 1954–56, seven insecticides were tested for the control of *Hylemyia cilicrura* (Rond.), *Limonius californicus* (Mannh.) and Lamellicorn larvae attacking turnips in southern California. Some 80 per cent. of the damage found was due to *Hylemyia*, which is destructive throughout the year, and 10 per cent. to each of the other pests, which are active in spring and early summer. When applied once, up to about three weeks before sowing, in 35 U.S. gals. emulsion spray per acre and thoroughly mixed in the soil, dieldrin at 2·3–3·3 lb. per acre gave almost complete control for one season and partial control for 18 months, and heptachlor and endrin at similar rates and aldrin at 3·9–4·2 lb. gave commercial control (less than 5 per cent. of the turnips showing injury) for one season. Isodrin at 2·6 lb. and toxaphene and DDT at 10·5 lb. per acre did not afford adequate protection. A test to compare granules with emulsion sprays of dieldrin and heptachlor was inconclusive, but dieldrin granules showed the most promise.

Kantack (E. J.) & Dahms (R. G.). **A Comparison of Injury caused by the Apple Grain Aphid and Greenbug to Small Grains.**—*J. econ. Ent.* **50** no. 2 pp. 156–158, 2 refs. Menasha, Wis., 1957.

The most important of the Aphids that infest small grains in the United States are *Toxoptera graminum* (Rond.) and *Rhopalosiphum fitchii* (Sand.) [the American apple-grain Aphid that has previously been misidentified as *R. prunifoliae* Fitch and is possibly identical with *R. annuae* (Oestl.) (*cf. R.A.E.*, A **19** 513; **35** 295)]. A comparison of the damage caused by them to wheat, barley and oats was made in the greenhouse in Oklahoma in 1952 and 1953, and the following is based on the authors' summary of the results.

On all three plants, symptoms of injury were caused much sooner by *T. graminum* than by *R. fitchii*, though prolonged infestation by large populations of the latter eventually produced damage comparable in severity to that caused by *T. graminum*. Plants that had been infested with *Toxoptera* were much more severely injured by exposure to a temperature of 19°F. for four hours than were uninfested plants. Wheat and oats that had been infested with *Rhopalosiphum* were slightly more susceptible to such injury than uninfested ones, but barley was less so. Feeding by *T. graminum* caused a marked delay in the formation of tillers, which appeared to be transitory in wheat and barley but more permanent in oats. This Aphid reproduced more rapidly than *R. fitchii* on all three crops, but the difference was very slight on wheat.

O'Brien (R. D.). **Properties and Metabolism in the Cockroach and Mouse of Malathion and Malaoxon.**—*J. econ. Ent.* **50** no. 2 pp. 159–164, 3 figs., 19 refs. Menasha, Wis., 1957.

Malathion (O,O-dimethyl S-(1,2-di(ethoxycarbonyl)ethyl) phosphorodithioate) is an insecticide of great interest because its toxicity to mammals is low, and insects do not develop resistance to it to the extent that they do to chlorinated hydrocarbons. Malaoxon (O,O-dimethyl S-(1,2-di(ethoxycarbonyl)ethyl) phosphorothiolate) is of interest as a probable metabolic product of malathion in both insects and mammals, and its production may account for the toxic effects of the latter [*cf. R.A.E.*, A **45** 186; **46** 96]. Its use as an insecticide and acaricide has also been suggested, as it lacks the odour of malathion. In the present paper, the results are given of studies on the properties and metabolism of malathion and malaoxon, and a mechanism for the selective toxicity of malathion is suggested on the basis of the data obtained.

The following is the author's summary. The stability, polarity, spectra and anticholinesterase activities of malathion and malaoxon are described. Evidence is given that malaoxon is a product of malathion metabolism in the cockroach [*Periplaneta americana* (L.)] and mouse. Mouse liver is shown to activate malathion, probably by oxidation to malaoxon, by means of a microsomal system requiring DPNH, Mg^{++} and nicotinamide. Although whole cockroach guts activate malathion, this property is lost on homogenization and only a little restored by addition of the above cofactors. In the mammal, malathion oxidation occurs primarily in the liver, and to a lesser extent in heart and perhaps testis. Malaoxon hydrolysis is vigorous in liver, kidney and lung. In the cockroach, fat body and midgut oxidise malathion; fat body hydrolyses malaoxon. The hydrolysing system of liver is in the soluble fraction, and is more active against malathion than malaoxon. The balance of oxidative (activating) and hydrolytic (degrading) activities in the mouse and cockroach accounts satisfactorily for the much greater toxicity of malathion for the cockroach than for the mouse.

Connin (R. V.) & Staples (R.). **Role of various Insects and Mites in the Transmission of Wheat Streak-mosaic Virus.**—*J. econ. Ent.* **50** no. 2 pp.168–170, 15 refs. Menasha, Wis., 1957.

Most of the common and some of the uncommon insects and mites found on wheat in Kansas and Nebraska were tested in 1951–53 for ability to transmit wheat streak mosaic, the most important virus disease of wheat in the region. The virus was not transmitted by Aphids of six species, and no transmission was obtained with other insects, except in tests considered unreliable, or with *Petrobia latens* (Müller), a mite that occasionally appears in numbers on wheat in late spring, but *Aceria tulipae* (Keifer) from artificially infected plants in the greenhouse or from infected wheat in the field in both States transmitted the virus to wheat in 66 of 78 tests; single viruliferous mites caused infection, and the initial symptoms developed in 5–7 days in all cases. It is, therefore, confirmed that this mite transmits wheat streak mosaic and it appears likely that it is the only vector in the Great Plains region [*cf. R.A.E.*, A **45** 274, etc.].

Flanders (S. E.). **Fig Scale Parasites introduced into California.**—*J. econ. Ent.* **50** no. 2 pp. 171–172, 4 refs. Menasha, Wis., 1957.

Although *Lepidosaphes ficus* (Sign.), an introduced pest of fig in California [*cf. R.A.E.*, A **38** 110], was attacked by natural enemies already present

in the State, these did not control it adequately, and additional parasites were introduced from the Mediterranean region in 1939–55. Attempts to colonise *Physcus testaceus* Masi in 1939–40 [*cf.* **31** 22], and subsequently, failed, but parasitised material of *L. ficus* and *L. ulmi* (L.) received from Italy and France in 1948–50 gave rise, in addition, to a species of *Archenomus* and *Aphytis mytilaspidis* (LeB.). Attempts to propagate the former failed, but it was decided to colonise the latter, although it already occurred in California and afforded 1·4 per cent. parasitism of *L. ficus*, in the hope that the introduced strain would prove more effective. It was liberated in March 1949, and adults of subsequent generations were recovered in April and July; it parasitised 67–100 per cent. of the scales collected at the colonising sites in 1954, had spread to other districts by 1955 and was causing important reductions in scale population in 1956.

Ellingboe (A. H.), Kernkamp (M. F.) & Haws (B. A.). **Sweetclover Weevil parasitized by *Beauvaria bassiana* (Bals.) Vuill. in Minnesota.** —*J. econ. Ent.* **50** no. 2 pp. 173–174, 2 figs., 9 refs. Menasha, Wis., 1957.

The following is based on the authors' introduction and summary. In recent years, the production of sweet clover [*Melilotus*] in Minnesota has been seriously reduced by *Sitona cylindricollis* Fhs., but in the spring of 1955, high natural mortality of this weevil was observed, and large numbers of the living and dead insects were found to be infested with *Beauveria bassiana*. Laboratory tests were therefore made to determine whether this fungus would infest and kill the weevil or whether its presence was merely secondary. The results proved conclusively that *B. bassiana* infested and killed both larvae and adults, and supported field observations that large numbers of adults were being killed by it. The fungus was easily propagated on potato-dextrose agar at temperatures of 23–25°C. [73·4–77°F.].

Smith (E. H.). **Field and Laboratory Evaluations of Lead Arsenate, Wettable Sulphur and Hydrated Lime against the Plum Curculio.**— *J. econ. Ent.* **50** no. 2 pp. 177–183, 4 graphs, 9 refs. Menasha, Wis., 1957.

The following is based on the author's introduction and summary. Lead arsenate is still extensively used against *Conotrachelus nenuphar* (Hbst.) on cherry and apple in the United States. Its exact mode of action is not known, and field tests on cherry and prune and laboratory tests on apple were carried out in New York to determine the effects of it in mixed sprays with hydrated lime and wettable sulphur and of these used alone. In the field tests, all treatments gave some reduction of fruit infestation; control was greater on cherry than on prune and varied roughly with the number of beetles inhabiting the trees after treatment. In the laboratory tests, in which females were caged individually on sprayed fruits, reductions occurred in the rate of feeding, in oviposition and in length of life, and there was a positive correlation between feeding and oviposition for all treatments. Some of the beetles died without feeding, presumably owing to desiccation. Those confined on fruits sprayed with lead arsenate showed 50 per cent. mortality in 19 days and were all dead in 51 days, indicating that the inherent toxicity of lead arsenate is low.

Since the combined spray affords satisfactory control under practical conditions, it is suggested that the residues are distasteful to the beetles,

causing them to desert the sprayed trees in search of more favourable situations. Those remaining feed at sub-normal levels, which results in reducing oviposition, and continued feeding ultimately causes death.

Semel (M.). **Control of the Carrot Weevil attacking Parsley.**—*J. econ. Ent.* **50** no. 2 pp. 183–184, 6 refs. Menasha, Wis., 1957.

Listronotus oregonensis (Lec.) has been a pest of parsley on Long Island for many years, and organic insecticides were tested for its control in 1956. They were applied to the soil surface once on 24th April, ten days after sowing and 13 days before the plants began to appear, in granular form or in 100 U.S. gals. emulsion spray per acre, or three times, on 16th May, when the plants were about half an inch high, and on 7th June and 13th or 25th July, after each cutting.

Treatment with 5·15 lb. heptachlor or 4·49 lb. dieldrin per acre in granules before the plants appeared reduced the numbers of injured plants by 94·3 and 89·4 per cent., respectively, whereas applications of 4·47–5·45 lb. dieldrin and 4·58–6·38 lb. heptachlor in granules and of 0·375 lb. dieldrin and 1 lb. heptachlor in emulsion sprays afterwards reduced them by 95·1–99·2 per cent. Treatments appeared to be effective for at least 22–33 days. Early treatment with 4 lb. heptachlor or dieldrin in emulsion sprays and late treatment with 3 lb. toxaphene or 1 lb. chlordane in sprays caused only 62·7–76·8 per cent. reduction in injured plants, but all reductions were statistically significant.

There was a heavily infested plot of parsley 50 ft. to the east of the experimental area, and the occurrence of 80·5 and 51 per cent. injury in the untreated plants nearest and furthest from this, respectively, suggested that the application of insecticides to sections of a planting most vulnerable to attack might prevent the movement of the weevil to other parts.

Smith (E. H.). **A Method for rearing the Plum Curculio under Laboratory Conditions including some Biological Observations.**—*J. econ. Ent.* **50** no. 2 pp. 187–190, 3 graphs, 3 refs. Menasha, Wis., 1957.

As studies on *Conotrachelus nenuphar* (Hbst.) have been hampered by lack of a method of rearing it under laboratory conditions, the author describes one developed in Geneva, New York, in 1949. Since the weevil has only one generation a year at Geneva, the adults hibernating before oviposition occurs, a multi-brooded strain was obtained from North Carolina and maintained continuously through nearly 40 generations. Green thinning apples were provided as food for both larvae and adults, and the life-cycle at 80°F. lasted an average of 57 days.

Comparison of the laboratory and the local strain under laboratory and insectary conditions showed that the pattern of adult behaviour was essentially the same, both maintaining high rates of feeding and oviposition for several weeks, followed by a gradual decline. Oviposition was proportional to feeding and was not resumed when it had once ceased, although feeding continued at a low rate for an extended period. The most striking difference in response of the two strains was in the production of eggs, the laboratory strain producing over twice as many as the local one, at a higher rate and over a longer period. Females of the laboratory strain lived for significantly longer than overwintered females of the local strain, and the adults of both sexes were about 25 per cent. larger and significantly more uniform in weight; females of both strains were slightly larger than males.

Riehl (L. A.), Wedding (R. T.), Rodriguez (J. L.) & LaDue (J. P.). **Effects of Oil Spray and of Variation in certain Spray Ingredients on Juice Quality of *Citrus* Fruits in California Orchards, 1950–1953.**—*J. econ. Ent.* **50** no. 2 pp. 197–204, 17 refs. Menasha, Wis., 1957.

In further investigations on the effects of oil emulsions on the quality of *Citrus* fruits [*cf. R.A.E.*, A **45** 270], sprays prepared with oils from various sources were applied to Valencia or navel oranges once a year in August or September or to lemon twice a year in April and in August or September in central and southern California in 1950–53 and compared with other treatments for their effect on the quality of the fruit juice.

The following is based on the authors' summary of the results. California spray oils from various sources and in various formulations, insecticidal or acaricidal sprays containing no oil, an emulsion of an isoparaffinic petroleum oil, fumigation with hydrogen cyanide and no treatment were compared with a proprietary emulsion containing 1·75 per cent. light-medium California spray oil, and differences in juice quality were in general found to be attributable to chance or to conditions obtaining in particular orchards. At odds of 19:1, the percentages of soluble solids in the juice were significantly higher after parathion sprays than after the standard oil spray in two of five comparisons of Valencia oranges and variable in the others, and not significantly higher in two of navel oranges. The maturity ratio of soluble solids to acid in the juice of navel oranges was consistently lower for the non-oil treatments (apparently because of a higher percentage of acid), the differences being significant for parathion but not for a combination of parathion and Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], fumigation with HCN or no treatment. The addition of 2,4-D (2.4-dichlorophenoxyacetic acid) to oil emulsions, to reduce leaf-drop [*cf.* **41** 80], did not influence juice quality except that the percentage of total soluble solids in the juice of navel orange was decreased significantly in three of six comparisons; four other variations of formulation had no effect. Highly paraffinic oils in 0·5–1 per cent. emulsions reduced the percentages of soluble solids in various comparisons with the standard emulsion on Valencia and navel orange, but the isoparaffinic oil did not, possibly because of its low molecular weight.

It is concluded that the reduction in soluble solids in orange juice caused by oil emulsions can probably be avoided by spraying in August or September [*cf.* **45** 270] and in accordance with recommended procedures. The dates selected for spraying lemons also seemed satisfactory, although adverse effects on juice quality appeared slightly more likely in April than in late summer.

Metcalf (R. L.), Stafford (E. M.), Fukuto (T. R.) & March (R. B.). **The Systemic Behavior of O,O-Diethyl S-2-(Diethylamino)ethyl Phosphorothiolate and its Salts.**—*J. econ. Ent.* **50** no. 2 pp. 205–210, 4 figs., 7 refs. Menasha, Wis., 1957.

The translocation of O,O-diethyl S-2-(diethylamino)ethyl phosphorothioate (thiol isomer) [*cf. R.A.E.*, A **44** 133] and its salts, particularly the hydrogen oxalate, in plants was investigated by the use of compounds labelled with ^{32}P and compared, in some cases, with that of its thiono isomer (O,O-diethyl O-2-(diethylamino)ethyl phosphorothioate) and demeton-S [O,O-diethyl S-2-(ethylthio)ethyl phosphorothioate].

When applications were made to the roots of lemon seedlings in culture solutions, the thiol isomer and its oxalate accumulated in the leaves at about equal rates, but when the compounds were applied to the stems of lemon

seedlings or cotton plants, the thiol isomer accumulated at about ten times the rate of the oxalate, showing the influence of lipoid solubility on penetration; there was little difference in rate of accumulation between the thiol and thiono isomers. In comparative studies [*cf.* **46** 46], demeton-S accumulated in cotton leaves about 3·2 times as rapidly as the thiol isomer; demeton-S, the thiol isomer and the oxalate gave rapid kills of *Tetranychus telarius* (L.) and *Heliothrips haemorrhoidalis* (Bch.) feeding on the leaves of the cotton, and other tests indicated that 11 parts per million of the thiol isomer in cotton leaves was necessary to give 50 per cent. mortality of *T. telarius* in 24 hours. The rates of penetration of the oxalate and six other salts of the thiol isomer were compared by topical application to cotton stems and found to be influenced by their solubility, the trichloroacetate and the picrate being absorbed in greater amounts than the oxalate over 16 days, but not over eight days. When lemon leaves were dipped in solutions, the thiol isomer penetrated much more rapidly than any of its salts, demeton-S or the thiono isomer.

The amounts and distribution of the oxalate in orange and lemon fruits were measured after these had been sprayed to run-off on the trees with 1·4 oz. per 100 U.S. gals., a dosage considered suitable for commercial practice. None was detected in the pulp of either fruit by radioassay, and the amounts in the peel reached 0·08 and 0·32 p.p.m., respectively, during the 28 days after application. Some peel and surface residues were also determined by inhibition of human red-cell cholinesterase, and the values obtained were in excellent agreement with those from radioassay. When applied to cotton seeds on the day before they were sown, the thiol isomer accumulated in the cotyledons and true leaves of the seedlings about 5–10 times as rapidly as the oxalate, and demeton-S more rapidly still. The plants were exposed to attack in the greenhouse by *Frankliniella tritici* (Fitch) but remained free of injury for 2–5 weeks, demeton-S giving protection for the longest and the oxalate for the shortest period.

No evidence of the metabolism of the thiol isomer or its oxalate to other toxicants could be detected by paper chromatography or paper electrophoresis of chloroform extracts or juices of treated lemon or cotton leaves.

Drooz (A. T.). **The Importance of *Mesoleius tenthredinis* Mor., a Parasite of the Larch Sawfly, in New York State.**—*J. econ. Ent.* **50** no. 2 p. 212, 3 refs. Menasha, Wis., 1957.

Between 1909 and 1956, reafforestation areas of New York were planted with some 36 million larch trees of two species (*Larix decidua* and *L. leptolepis*), both of which are subject to attack by *Pristiphora erichsonii* (Htg.). As *Mesoleius aulicus* (Grav.) (*tenthredinis* Morl.), an important parasite of this sawfly, had recently been reported to afford only 5 per cent. parasitism or less of the larvae in Canada [*cf. R.A.E.*, A **44** 183], Minnesota [*cf.* **42** 156] and Wisconsin, cocoons from a small plantation of *L. leptolepis* in Chenango County were collected in August 1956 and examined for the parasite, which was found attacking 53 of the 95 living larvae obtained; no other parasites were found. It is concluded that *M. aulicus* is still an important parasite of *P. erichsonii* in New York.

Kinghorn (J. M.). **Two practical Methods of identifying Types of Ambrosia Beetle Damage.**—*J. econ. Ent.* **50** no. 2 p. 213, 1 fig. Menasha, Wis., 1957.

Trypodendron lineatum (Ol.) and *Gnathotrichus sulcatus* (Lec.), the commonest ambrosia beetles in British Columbia, differ considerably in

habits and in the damage they cause to wood, and the author describes a method of distinguishing between the entrance holes of the two by means of a drill with a diameter small enough to fit into the smallest *Trypodendron* hole but too large for the largest made by *Gnathotrichus*. The wood fragments extruded during construction of the egg gallery by *Trypodendron* consist of irregularly sized particles that tend to cling together even when dry, whereas those of *Gnathotrichus* consist of loose comma-shaped particles of uniform size.

Ditman (L. P.) & Kramer (A.). **Progress Report on a regional Approach to the Problem of Flavor Evaluation of Fruits and Vegetables as influenced by Pesticides.**—*J. econ. Ent.* **50** no. 2 pp. 213–214, 2 refs. Menasha, Wis., 1957.

A combined investigation on the effect of insecticides and other chemicals used in plant protection on the flavour of fruits and vegetables was begun in the north-eastern United States in 1954. A multiple-comparison type of test was considered a better method of evaluating flavour than a triangular or paired comparison procedure, since the results obtained by different panels would probably be reproducible and would lend themselves to statistical treatment. Preliminary results obtained at three stations in 1954 were in reasonable agreement, except when factors other than the chemicals were variable. There was similar agreement in 1955–56, when little difference in effectiveness was found between an untrained panel of 35–40 and a trained panel of 5–7 judges.

Rhode (R. H.). **A Diet for Mexican Fruit Flies.**—*J. econ. Ent.* **50** no. 2 p. 215, 2 refs. Menasha, Wis., 1957.

In connection with investigations in Mexico, a diet of orange-juice crystals and sugar, mixed together, and yeast hydrolysate, given separately, was found to stimulate and maintain high production and viability of the eggs of *Anastrepha ludens* (Lw.). In tests made in 1954 and 1955, with 80 pairs of adults kept at a mean temperature of 77°F. and about 50 per cent. relative humidity, averages of 1,056 and 1,769 eggs per female were deposited in 87 and 73 days, respectively. Samples, taken mainly from the first three-quarters of the eggs laid by four females that produced some 3,000–4,000 each showed 85–93 per cent. viability; those of another showed lower viability, which decreased to zero in the later eggs.

MacCreary (D.). **Alfalfa Weevil Control in Delaware, 1955, with Observations on Pea Aphid and Meadow Spittlebug.**—*J. econ. Ent.* **50** no. 2 pp. 215–216, 2 refs. Menasha, Wis., 1957.

Further tests on the control of *Hypera variabilis* (Hbst.) (*postica* (Gylh.)) on lucerne in Delaware [*cf. R.A.E.*, A **44** 165–166] were made in 1955, when 4 oz. dieldrin or heptachlor and 3·2 oz. endrin were applied in 25 U.S. gals. emulsion spray per acre on 13th April. The mean temperature was 45·5°F., and 0·67 inch rain fell during the following night and morning. Counts of larvae and adults on treated and untreated plants showed that the first two compounds resulted in 92–96 per cent. control from 15th to 30th April (as calculated by Abbott's formula [*cf.* **13** 331]) and 86 and 74 per cent. on 4th May. Endrin was effective against the larvae but not the adults, and dieldrin and heptachlor ceased to control the adults from 4th May. The numbers of larvae increased greatly on all plots between 4th and

12th May and again between 12th and 20th May, but the three insecticides resulted in 45–74 per cent. reduction by 12th May and dieldrin and endrin 59 and 50 per cent. by 20th May. However, the considerable population increases in all plots resulted in severe injury to the hay by 26th May, regardless of the insecticide used. The stubble was not treated, and new growth appeared much sooner on treated than on untreated plots; yields from the second cutting averaged 3,039 and 2,516 lb. per acre, respectively.

Dieldrin and heptachlor gave no control of *Macrosiphum pisum* (Harris), but the population of this Aphid was 16 times as great on untreated plots as on those treated with endrin. Dieldrin, heptachlor and endrin reduced the numbers of spittle masses of *Philaenus leucophthalmus* (L.) on 19th May from 4·9 to 0·07, 1·2 and 0·03 per sq. yard, respectively.

Muka (A. A.). **Alfalfa Weevil Control with Granulated Insecticides in Virginia.**—*J. econ. Ent.* **50** no. 2 pp. 216–218, 1 fig., 3 refs. Menasha, Wis., 1957.

The distribution of *Hypera variabilis* (Hbst.) (*postica* (Gylh.)) on lucerne in Virginia increased from two counties in 1952 to 70 in 1956. Several chlorinated hydrocarbons give excellent control of this weevil in spring, but they have been shown to require careful timing [*cf. R.A.E.*, A **43** 49], and more than one application may be needed in some seasons; granular insecticides applied during the dormant period were therefore tested in 1955–56. The granules were applied with a fertiliser spreader, and treatment on 29th December resulted in 85·4 per cent. reduction in the number of larvae on 11th May for 1·5 lb. actual heptachlor per acre and in 13·9–43·4 per cent. reduction for 1·5 lb. aldrin, 1 lb. dieldrin or 2·5 lb. lindane [almost pure γ BHC]. Treatment on 30th March, when spring growth was beginning, resulted in 98·8 per cent. reduction for heptachlor and in 51·5–66·6 per cent. for the other materials; parathion at 2·5 lb. per acre caused 31·5 per cent. reduction when applied in December but none when applied in March. The superiority of heptachlor over aldrin and dieldrin may have been due to the fact that it was applied in a greater bulk of granules.

Duda (E. J.). **The Use of Chlorinated Polyphenyls to increase the effective Insecticidal Life of Lindane.**—*J. econ. Ent.* **50** no. 2 pp. 218–219. 3 refs. Menasha, Wis., 1957.

In further tests of the value of Aroclor 5460 (a chlorinated polyphenyl) in extending the period of effectiveness of lindane [almost pure γ BHC] in sprays applied to foliage [*cf. R.A.E.*, A **44** 177, etc.], small elm saplings were sprayed to run-off on different dates from 12th June with suspensions of 1 lb. 25 per cent. wettable γ BHC per 100 U.S. gals., with or without 1 lb. Aroclor in xylene, with an emulsifier, and subjected to weathering during June and July. Leaves were removed on 28th June and infested with larvae of *Galerucella luteola* (Müll.) (*xanthomelaena* (Schr.)) and on 7th or 22nd August and infested with the adults. The mixture gave complete mortality in two days of larvae exposed to the leaves 4–14 days after treatment and in 2–3 days of adults exposed after 8–41 days; it also gave 50–90 per cent. kill in three days of adults exposed after 58–71 days. Without Aroclor, γ BHC required five days to give complete mortality of larvae exposed 4–11 days after treatment and did not give complete kill in any other test; it had little or no effect on adults put on the leaves 58–71 days after treatment. Aroclor showed some toxicity to the adults when used alone in a preliminary test, and it is possible that there is a synergistic effect when it is added to BHC.

Vanderzant (E. S.). **Growth and Reproduction of the Pink Bollworm on an Amino Acid Medium.**—*J. econ. Ent.* **50** no. 2 pp. 219–221, 3 refs. Menasha, Wis., 1957.

The author describes the composition and preparation of a chemically defined medium that provided an optimum diet for the growth and reproduction of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.), obtained by substituting l-amino acids for the casein in the medium previously used [*R.A.E.*, A **45** 346]. It contained about 2 g. per 100 ml. of amino acids, of which two-thirds comprised the ten essential ones, in proportions similar to those found in cotton seeds. The amounts of other amino acids, vitamins, choline, salts and cholesterol were greater than those previously found necessary. Larvae reared on the medium developed in normal periods and gave rise to normal pupae and adults, and the females deposited large numbers of viable eggs. A second generation was reared in the same way.

Sengupta (G. C.) & Rout (G. D.). **Control of Rice Stem Borer with Endrin.**—*J. econ. Ent.* **50** no. 2 p. 221, 2 refs. Menasha, Wis., 1957.

Schoenobius incertulas (Wlk.) is considered the most destructive insect pest of the spring rice crop in Orissa, India, because it attacks the plants throughout their growth. In a test on its control in 1955, rice was planted in early January and sprayed with an emulsion concentrate containing 19·5 per cent. endrin at 12, 16 or 32 oz. per acre on 4th and 27th February, during the peak period of attack. Examination 15 days after each application showed that all treatments reduced moth activity and the numbers of egg masses and dead hearts, and increased the numbers of tillers, and that the highest dose was more effective than the others.

Fleschner (C. A.) & Scriven (G. T.). **Effect of Soil-type and DDT on Ovipositional Response of *Chrysopa californica* (Coq.) on Lemon Trees.**—*J. econ. Ent.* **50** no. 2 pp. 221–222. Menasha, Wis., 1957.

During a study in California of mite populations on six young lemon trees grown from cuttings taken from the same tree at the same time, it was observed that naturally occurring females of *Chrysopa californica* Coq., which is predacious on mites, consistently laid more eggs on some trees than on others. The trees were growing outdoors in large oil drums, three in a loose sandy soil and three in a compact silt soil, and 0·64 oz. 50 per cent. wettable DDT was added to the soil of one drum in each set on the first of each month from June until December 1955. Each night, the Chrysopid laid more eggs on the trees growing in the loose soil than on the others and more on those treated with DDT than on the corresponding untreated ones.

In 1956, the trees were kept free of all mites or insect pests for most of the period from 3rd February to 12th October, and one of each pair of trees in untreated soil was sprayed with 2 lb. 50 per cent. wettable DDT per 100 U.S. gals. on 15th June and 3rd August. Totals of 386 and 600 eggs were laid on the trees in the compact and loose soils, respectively, comprising 62 and 153 for no treatment, 146 and 248 for soil treatment with DDT and 178 and 199 for the DDT spray.

Woodworth (C. E.) & Lane (M. C.). **Insecticide Residues in Wireworm Control.**—*J. econ. Ent.* **50** no. 2 pp. 222–223. Menasha, Wis., 1957.

In an investigation of the periods for which various insecticides applied to the soil would remain toxic to wireworms and so prevent reinfestation from

eggs laid by females originating elsewhere, the toxicants were applied in the autumn of 1953 to plots in a heavily infested field near Prescott, Washington, in which *Limonius californicus* (Mannh.) was the principal species, and large wireworms were exposed in cans for three months to soil samples taken after various intervals. In samples taken after a month, there was 85–100 per cent. mortality in soil treated with 2 or 4 lb. heptachlor or dieldrin, 3 or 6 lb. aldrin or 20 lb. DDT per acre, 71, 56 and 81 per cent. in that treated with 10 lb. DDT and 4 and 8 lb. chlordane and 42–57 per cent. in untreated soil. After a year, when mortality in untreated soil was 68–76 per cent., heptachlor at both rates and the other materials at the higher ones resulted in 90 per cent. mortality or more, whereas the other treatments gave doubtfully significant control. After two years, there was 47–48 per cent. mortality in untreated soil and 94 and 90 per cent. in that treated with 4 lb. heptachlor and 4 lb. dieldrin, respectively, and all other treatments except 3 lb. aldrin and 4 lb. chlordane gave significant control.

When newly hatched larvae were exposed for 60 days to samples of the same soils taken 18 months after treatment, heptachlor and chlordane at both rates and aldrin, dieldrin and DDT at the higher ones gave complete mortality, aldrin and dieldrin at the lower ones gave almost complete kill and 10 lb. DDT caused a significant reduction, indicating that reinfestation would be prevented in the field even though the insecticide were no longer toxic to larger wireworms. In order to avoid accumulating undesirable residues in the soil, therefore, treatments should not be repeated until reinfestation occurs and there is again risk of damage to crops.

Hansen (H. L.) & Dorsey (C. K.). **Effects of granular Dieldrin and Heptachlor on Adult Weevil Populations in Red Clover.**—*J. econ. Ent.* **50** no. 2 p. 224, 2 refs. Menasha, Wis., 1957.

In tests in 1956, insecticides were applied against the meadow spittlebug [*Philaenus leucophthalmus* (L.)] on clover in West Virginia at its time of hatching [*cf. R.A.E.*, A **44** 383], and since this coincided partly with the period of oviposition of *Sitona hispidulus* (F.), *Hypera nigrirostris* (F.) and *H. meles* (F.), observations were made on their effect on these weevils, which are repeatedly in contact with the soil surface when laying eggs. Dieldrin and heptachlor were applied at 0·5 lb. per acre in granules on 26th April and heptachlor at 6 oz. in an emulsion spray on 3rd May, and counts of adults on treated and untreated plots in May showed that the three treatments resulted in 95·8, 98·3 and 98·4 per cent. reduction in numbers of *S. hispidulus*, 92·9, 96·2 and 99·5 per cent. reduction of *H. nigrirostris* and an increase and 48·4 and 71·3 per cent. reduction of *H. meles*, respectively. Reinfestation from outside the field probably caused the increase in *H. meles*.

DePew (L. J.). **Control of Corn Earworm in Sorghum Heads by aerial Spraying in southwestern Kansas.**—*J. econ. Ent.* **50** no. 2 pp. 224–225, 2 refs. Menasha, Wis., 1957.

In the summer of 1956, several fields of sorghum in south-western Kansas had 60–80 per cent. of the heads infested by up to four larvae of *Heliothis zea* (Boddie) each [*cf. R.A.E.*, A **44** 131], and emulsion sprays, applied at 3 U.S. gals. per acre by an aeroplane flying a foot above the plants on 10th September, were tested for their control. Subsequent examination of treated and untreated plots showed that 0·5 lb. Phosdrin [dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate], 2 lb. DDT, 1 lb. malathion, 0·5 lb.

endrin and 0·5 lb. parathion per acre reduced larval populations by 95, 83, 81, 74 and 71 per cent., respectively, in one day and by 100, 92, 89, 94 and 86 per cent. in four.

ARMITAGE (H. M.). **Successful Eradication of Mexican Bean Beetle in California.**—*Bull. Calif. Dep. Agric.* **45** no. 3 pp. 238–248, 7 figs., 1 map. Sacramento, Cal., 1956.

Epilachna varivestis Muls. was found on beans in Ventura County, for the first time in California, in 1946, and a campaign for its eradication was begun shortly after. The measures adopted [*cf. R.A.E.*, A **36** 396; **37** 294], the research on which they were based [*cf.* **38** 237], and the results achieved year by year are reviewed in detail, and it is stated that no examples of the beetle were taken in the county after July 1950, despite continued surveys. The cost of the eradication work was less than a million dollars, which is only a small fraction of the annual value of the bean crop.

RAIZENNE (H.). **Forest Sawflies of southern Ontario and their Parasites.** —*Publ. Dep. Agric. Can.* no. 1009, 45 pp., 1 fldg. chart, 1 map. Ottawa, 1957.

This is a compilation of data on 90 species of sawflies collected from forest trees in southern Ontario and neighbouring areas of Quebec and reared in the laboratory between 1936 and 1952. It consists essentially of a systematic list of the species showing for each the years in which it was recorded, its food-plants and distribution in the area, its seasonal history, the numbers of collections and specimens received and, where any, the parasites reared from it, with similar information on them and on the degree of parasitism. A table shows the distribution of the sawflies by county.

TRIPP (H. A.) & HEDLIN (A. F.). **An ecological Study and Damage Appraisal of White Spruce Cone Insects.**—*For. Chron.* **32** no. 4 pp. 400–410, 10 figs., 9 refs. Toronto, 1956.

Insects cause considerable reductions in the yield of seed of white spruce [*Picea glauca*] in Ontario and Saskatchewan. The most injurious are those that feed entirely within a single cone, and they comprise *Cydia* (*Laspeyresia*) *youngana* (Kearf.) [*cf. R.A.E.*, A **44** 223], *Hylemyia* (*Pegohylemyia*) *anthracina* (Czerny), *Dasyneura canadensis* Felt, *D. rachiphaga* Tripp, *Phytophaga carpophaga* Tripp and two unidentified Cecidomyiids. Sporadic losses are also caused by *Dioryctria reniculella* (Grote), *D. abietella* (Schiff.), *Choristoneura fumiferana* (Clem.), *Paralobesia* (*Polychrosis*) *piceana* (Freeman) and *Eupithecia togata mutata* Pearsall. Notes on the habits of these insects are given, and their importance in destroying the seed is assessed. *C. youngana* is the most injurious in both Provinces.

LLOYD (D. C.). **Remarks on a possible Biological Control Program with the Weed** *Acanthospermum hispidum* **D.C.**—*Canad. Ent.* **88** (1956) no. 11 pp. 613–622, 21 refs. Ottawa, 1957.

The following is based almost entirely on the author's summary. *Acanthospermum hispidum*, an annual plant of South American origin, has become a noxious weed in parts of northern Nigeria, and since chemical methods proved unsatisfactory for its control, its status in South America was investigated in order to assess the possibility of controlling it by means of introduced

insect enemies. A survey during March–August 1953 showed it to be abundant on wasteland, by roadsides, and in crops and pastures in habitats recalling those of northern Nigeria in many parts of Argentina and Brazil. Specific insect enemies were scarce and very ineffective in both these countries. Aphids, including *Macrosiphum* spp., and Cicadellids of the genus *Agallia* were the dominant insects on the plant. There was a singular absence of leaf-eating species, and the occasional Geometrid and Coleopterous larvae collected were apparently casual or accidental feeders. No insects attacked the flowers or seeds. In the Tucumán area of northern Argentina, a pronounced inhibition of flower and seed production was observed in some stands, but the cause was not known. The incidence of the plant in Venezuela and Colombia was very low. No insect or disease control agents were seen during a survey lasting three weeks, and no obvious reason for the scarcity of the plant can be advanced. It is concluded that the possibilities of controlling the weed in Nigeria by entomological means are very limited. Experience in the biological control of weeds has shown the importance of selecting insects from areas within the natural range of the plant in which climatic characteristics are similar to those of the invaded area. No areas with climatic conditions approaching those of northern Nigeria were found within the range of *A. hispidum* in South America.

Hedlin (A. F.). **Notes on the Life History and Habits of a Chalcid, *Bruchophagus caraganae* (Nik.), (Hymenoptera: Chalcididae), infesting Seeds of Caragana.**—*Canad. Ent.* **88** (1956) no. 11 pp. 622–625, 6 figs., 5 refs. Ottawa, 1957.

Caragana arborescens, which was introduced as seed from Russia in 1887, is used widely and *C. frutescens* and *C. pygmaea* less commonly for shelter belts in the Canadian prairies. During attempts in Saskatchewan in 1947 to produce improved strains, large percentages of the seeds were found to be destroyed by a Eurytomid identified as *Bruchophagus* (*Eurytoma*) *caraganae* (Nikol'skaya) [*cf. R.A.E.*, A **43** 110]. This Eurytomid occurs in the prairies wherever *Caragana* is grown and attacks all three species. Observations showed that the adults usually emerge during June and the first half of July and pair on the day of emergence. Oviposition, which may begin on the same day, occurred during the last three weeks of June and the first week in July. The eggs were deposited in the seeds, usually singly and preferably in those in which the cotyledons had begun to form; where two or three were present in one seed, only one larva became fully grown. The females also punctured the seeds without ovipositing and fed on the exudate. The larvae hatched in a minimum of seven days and fed on the cotyledons, which they destroyed. They overwintered, and subsequently pupated, in the seed coats on the ground, and their development normally lasted 11 months. In 1950, 105 larvae were transferred to gelatin capsules, but only 34 adults emerged. Pupation occurred between 23rd May and 19th June, and the pupal stage averaged 15·9 days for 23 males and 17 days for females. Further pupation and emergence took place in the spring of 1951.

Parasites reared from infested seeds comprised *Amblymerus bruchophagi* (Gah.), *Eupelmella vesicularis* (Retz.), *Habrocytus* sp., *Pachyneuron* sp. and *Coelopisthia* sp., of which only *A. bruchophagi* was abundant. In 1949, the percentage parasitism in seeds of *C. pygmaea* and *C. frutescens* collected in Saskatchewan amounted to 26·7 and 21·4, respectively, and parasitism in seeds of *C. pygmaea* from Manitoba was also observed. Infestation by *B. caraganae* in seeds of *C. arborescens* from Manitoba, Saskatchewan and Alberta averaged 48·7, 25·1 and 27·1 per cent., respectively, in 1949 and

32, 27·1 and 24·8 in 1950; the highest infestation was 95 per cent. in a sample from Alberta in 1950. Infested seeds become discoloured and a dark brown patch develops over the area where the larva is feeding; at maturity, they are undersized, uneven and dull brown in colour. Where the seed is to be used for propagation, the presence of infested seeds does not present a serious problem, since they can readily be removed by means of a fanning mill, but even small losses are of considerable importance in breeding work.

Hobbs (G. A.). **Ecology of the Leaf-cutter Bee** *Megachile perihirta* **Ckll. (Hymenoptera: Megachilidae) in Relation to Production of Alfalfa Seed.**—*Canad. Ent.* **88** (1956) no. 11 pp. 625–631, 1 fig., 7 refs. Ottawa, 1957.

Observations were made in 1950–54 on the bionomics of *Megachile perihirta* Ckll., an important pollinator of lucerne in southern Alberta [*cf. R.A.E.*, A **45** 57]. The dates on which the flight period began and ended varied from 12th June to 5th July and from 24th to 31st July, respectively. Both the date of emergence and the duration of the flight period appeared to be related to temperature, the former to that prevailing during metamorphosis and the latter inversely to that prevailing at the time; the earlier the bees emerged, the longer was the flight period. Daily activity was limited to periods between sunrise and about one hour before sunset during which the air temperature exceeded 64°F., and about one-third of the working day was spent in collecting pollen and nectar. Each bee probably works for an average of 15 days. From these and other observations, it is estimated that one female is responsible for the production of about 2 lb. seed per season. The number of bees required for adequate pollination is, in consequence, so low that even where good seed yields are obtained, few are seen and their importance is often overlooked. Yields fluctuate from year to year, and lack of synchronisation between the flight period and the flowering date of the crop, which in 1954 began ten days before the flight period and was concurrent with it for only a week, is considered to be an important cause. It can be overcome by clipping the plants, so that flowering begins about 1st July.

MacPhee (A. W.) & Sanford (K. H.). **The Influence of Spray Programs on the Fauna of Apple Orchards in Nova Scotia. X. Supplement to VII. Effects on some beneficial Arthropods.**—*Canad. Ent.* **88** (1956) no. 11 pp. 631–634, 1 ref. Ottawa, 1957.

This part of a series dealing with long-term investigations of the effects of sprays on the arthropod fauna of apple orchards in Nova Scotia [*cf. R.A.E.*, A **45** 486, etc.] is supplementary to an earlier one [**43** 357] and contains a revised table, based on observations in 1947–55, showing the effects of spray materials on predacious mites and insects and parasitic Hymenoptera attacking the various pests. Three additional predators are included, *Typhlodromus tiliae* Oudm., *Phytoseius macropilis* (Banks) and *Deraeocoris nebulosus* (Uhl.); all three feed on phytophagous mites and the last (a Mirid) possibly also on the larvae of *Spilonota ocellana* (Schiff.) and *Cydia* (*Carpocapsa*) *pomonella* (L.) and on Aphids. The additional spray materials include malathion and Perthane (1,1-bis(p-ethylphenyl)-2,2-dichloroethane [ethyl-DDD]), which were harmful to natural enemies. ryania, Genite 923 (50 per cent. 2,4-dichlorophenyl benzenesulphonate) and Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite),

which were harmful to some species but not to others, and Chlorocide (p-chlorobenzyl p-chlorophenyl sulphide), and several fungicides, which were relatively harmless.

Wishart (G.), Doane (J. F.) & Maybee (G. E.). **Notes on Beetles as Predators of Eggs of** *Hylemya brassicae* **(Bouché) (Diptera: Anthomyiidae).**—*Canad. Ent.* **88** (1956) no. 11 pp. 634–639, 7 refs. Ottawa, 1957.

In connection with observations on the natural enemies of maggots attacking cruciferous crops at Belleville, Ontario, investigations were made in 1953–55 on the predators that destroy the eggs of *Hylemyia brassicae* (Bch.), which are always much more numerous than the larvae that hatch from them. The following is based on the authors' summary of the results. Large numbers of eggs were destroyed by predacious beetles, especially *Bembidion quadrimaculatum oppositum* Say and *B. nitidum* (Kby.). There was no indication of specificity in the food requirements of these Carabids, and their abundance depended mainly on the general type of ground cover.

Beard (R. L.). **Two Milky Diseases of Australian Scarabaeidae.**—*Canad. Ent.* **88** (1956) no. 11 pp. 640–647, 6 figs., 8 refs. Ottawa, 1957.

During a search for disease organisms of Lamellicorn larvae in Australia in 1953, two bacteria of the milky-disease complex were found infecting larvae of *Sericesthis pruinosa* (Dalm.) in a lawn at Canberra and *Heteronychus sanctae-helenae* Blanch. in a maize field in New South Wales, respectively. The symptoms caused were similar to those described for *Bacillus popilliae* and *B. lentimorbus* in *Popillia japonica* Newm. in the United States [*cf. R.A.E.*, A **35** 390]. The bacterium on *S. pruinosa* closely resembled *B. lentimorbus* in appearance and also resembled it in infecting larvae of *P. japonica* and *Anomala orientalis* Waterh. in laboratory tests, but differed from it in infecting third-instar larvae of *S. pruinosa* of all ages, instead of only the younger ones, in infecting larvae of *Aphodius howitti* Hope and *H. sanctae-helenae* and in failing to infect larvae of *Ascrica* (*Autoserica*) *castanea* Arr.; it is therefore described as *B. lentimorbus* var. *australis*, n. Spore suspensions injected into the alimentary tract of larvae of *S. pruinosa* at concentrations of 15,000 and 45,000 spores per larva caused symptoms to develop in one out of 15 and four out of 16, respectively. The spore stage was the only one present in the field infection, which was discovered in early June. The other bacterium was distinct in appearance and is described as *B. euloomarahae*, sp. n. In addition to *H. sanctae-helenae*, it infected larvae of *S. pruinosa*, *P. japonica*, *A. castanea* and *Anomala orientalis* into which spore suspensions were injected, and also developed, though in reduced numbers, in larvae of *Oryctes rhinoceros* (L.) in experiments in Western Samoa [*cf.* **46** 158]. The field infection was found in early December, when some of the larvae contained mature spores and other vegetative stages, and transmission of the bacterium was evidently in progress.

Proverbs (M. D.). **Chemical Control of the Pine Needle Scale,** *Phenacaspis pinifoliae* **(Fitch) (Homoptera: Diaspididae), in British Columbia.**—*Canad. Ent.* **88** (1956) no. 11 pp. 653–655, 5 refs. Ottawa, 1957.

Ponderosa pine [*Pinus ponderosa*], Engelmann spruce [*Picea engelmanni*] and other conifers in the Okanagan Valley of British Columbia have in

recent years been rendered unsightly by large populations of *Phenacaspis pinifoliae* (Fitch), and insecticides were tested for control of this Coccid on ponderosa pine in 1955. Observations on 12th September showed that the mortality percentages were 100 for sprays of 2 or 6 lb. 25 per cent. wettable malathion or diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate) per 100 gals. applied to run-off by hand-gun machine on 11th July, when 75 per cent. of the overwintered eggs had hatched, and again in mid-August, when hatching was complete but fresh oviposition had not yet begun, 98·7 and 100 for 2 and 4 gals. liquid lime-sulphur (specific gravity 1·28) applied on 11th July only, and 99·4 for 8 gals. lime-sulphur, 86·8 and 92·8 for the two concentrations of malathion and 90·8 for the higher concentration of diazinon applied in mid-August only, as compared with 11 for no treatment. Lime-sulphur controlled all stages and did not injure the trees, and malathion and diazinon were evidently more toxic to the nymphs than to the mature scales. In a concurrent test with concentrated sprays applied by turbine sprayer, the mortality percentages were 100 for 20 lb. 25 per cent. wettable malathion per 100 gals. with or without 1 quart non-ionic water-soluble surfactant, applied on 11th July and 11th August, and 94 and 90·8 for the same spray with and without the surfactant, respectively, on 11th August only.

Wishart (G.). **Effects of Hydrogen Ion Concentration on Hatching of Eggs of *Aplomya caesar* (Ald.) (Diptera: Tachinidae).**—*Canad. Ent.* **88** (1956) no. 11 pp. 655–656, 3 refs. Ottawa, 1957.

The Tachinid parasite, *Zenillia* (*Aplomya*) *caesar* (Aldr.), develops in larvae of a relatively small number of Lepidoptera in about ten genera, though the eggs are laid on a wide range of plants and are doubtless ingested by a variety of phytophagous insects [*cf. R.A.E.*, A **35** 139]. Eggs ingested by *Pyrausta nubilalis* (Hb.) hatch in the foregut or forepart of the midgut in about 15 minutes, and those that do not do so are excreted. When eggs of which the chorion had been cracked, as occurs when the egg is eaten, were placed in distilled water on a microscope slide and a drop or two of a 5 per cent. solution of potassium hydroxide was placed beside the cover slip, they hatched rapidly as the alkaline solution diffused beneath the slip. In further tests, the eggs hatched in about 15 minutes when placed in solutions of potassium hydroxide with pH values of 11·75–12·5; some hatching occurred, though slowly, at a pH value of 9, but the larvae died in the process of hatching at values above 12·5. The high degree of alkalinity required to initiate hatching is not common in the digestive juices of Lepidopterous larvae and probably accounts for the restricted host range of the parasite.

Harcourt (D. G.). **Occurrence of a DDT-resistant Strain of the Cabbage Looper, *Trichoplusia ni* (Hbn.), in the Ottawa Valley.**—*Canad. J. agric. Sci.* **36** no. 6 pp. 430–434, 8 refs. Ottawa, 1956.

In 1955, DDT dusts failed to control Lepidopterous larvae on late cabbage and cauliflower in some commercial plantings in the Ottawa Valley, even where the recommended number of applications [*cf. R.A.E.*, A **42** 52] was increased to ten or the concentration was doubled, and it gave only 59 per cent. control in field tests on cabbage, as compared with 96–100 per cent. in 1953–54 [**45** 256]. Counts of larvae on dusted and untreated plants one week after each of the four applications showed that control of *Pieris rapae* (L.) and *Plutella maculipennis* (Curt.) was excellent, and that populations

of these species were not outstandingly great, whereas *Trichoplusia ni* (Hb.), which is usually of little importance [*cf.* **45** 228], was four times as numerous as in the previous six years and poorly controlled. In a laboratory experiment, mortality among 125 larvae of *T. ni* in all instars that were collected near Ottawa and confined singly with disks of cabbage leaf cut from plants dusted with 3 per cent. DDT at 33 lb. per acre earlier in the day was only 24·8 per cent. after 72 hours, and the survivors completed their development normally on untreated foliage. It is concluded that the failure of DDT to give control was due to the appearance of a strain of *T. ni* resistant to this material [*cf.* **43** 235–236].

MacCarthy (H. R.). **A Ten-year Study of the Climatology of** *Melanoplus mexicanus mexicanus* **(Sauss.) (Orthoptera: Acrididae) in Saskatchewan.** —*Canad. J. agric. Sci.* **36** no. 6 pp. 445–462, 8 maps, 17 refs. Ottawa, 1956.

Between 1943 and 1952, grasshopper populations in southern Saskatchewan rose to very high levels and then fell to the lowest recorded in 20 years. Estimates of the population of *Melanoplus mexicanus mexicanus* (Sauss.) were made in various areas during the period and are here related to meteorological data. The following is based on the author's summary of the results. High correlation coefficients were found between population indices for the adults and weather factors up to 14 months previously, and suggested causal relationships. The most critical months were June, August and September of the previous year, corresponding to the periods of hatching, nymphal development and oviposition, respectively, and June of the current year. Temperature influenced subsequent populations more than any other factor, especially the daily minima during the previous June and August and the daily maxima during the previous August and the current June. Sunshine was important during September and, to a lesser extent, August. There was a high negative correlation with rainfall during the previous August and September and an erratic one with evaporation.

Wood (G. W.). **Note on Injury to Blueberry Sprouts by the Blueberry Thrips,** *Frankliniella vaccinii* **Morgan (Thysanoptera: Thripidae).**— *Canad. J. agric. Sci.* **36** no. 6 p. 510, 2 refs. Ottawa, 1956.

Frankliniella vaccinii Morg. has since 1947 become a pest of low-bush blueberries in New Brunswick and Nova Scotia. In crop fields, the infested buds, usually terminal ones, appear to be enlarged, owing to the failure of the leaves to unfold normally [*cf. R.A.E.*, A **31** 11] and few buds are affected per plant, but in fields in which the plants are sprouting after being burned, the leaves on infested plants wrap round the stems and often enclose entire shoots; both types of injury are frequently associated with reddening of the foliage. Damage, which is usually concentrated in patches, becomes apparent in early June in crop fields and by the third week of June in fields of newly sprouting plants. The importance of the injury in the latter was investigated in New Brunswick in 1954, when 100 infested plants were marked in July. By October, bud growth was retarded on most of them, there were dead tips on several, of which the stems were completely enclosed by leaves, and new terminal twigs had developed on some of these latter. By May 1955, when the flowers were forming, six plants were dead, 81 had no flowers, and the average number of flowers per plant was reduced from 26 to six on the rest. Since this reduction was due chiefly to infestation by *F. vaccinii*, control measures should evidently be applied to sprouting as well as to cropping plants.

Maxwell (C. W.) & Pickett (A. D.). **Insects affecting the Cranberry.**—*Publ. Dep. Agric. Can.* no. 810 (revd.) pp. 25–28. Ottawa, 1957.

The more important of the insects that attack cultivated cranberry in the Maritime Provinces of Canada are *Mineola vaccinii* (Ril.), *Rhopobota naevana* (Hb.), *Cingilia catenaria* (Dru.), *Scleroracus* (*Ophiola*) *vaccinii* (Van D.) and *Clastoptera saint-cyri* Prov. (*vittata* Ball). Notes are given on their bionomics and control.

Missonnier (J.). **Particularités écologiques de la mouche de la betterave** (*Pegomyia betae* **Curt.**) **dans le Bassin parisien.**—*C. R. Acad. Agric. Fr.* **43** no. 3 pp. 133–137, 4 refs. Paris, 1957.

Pegomyia hyoscyami var. *betae* (Curt.) proved unusually injurious to beet in northern France in 1954–56 [*cf. R.A.E.*, A **45** 248]. In 1954, damage was severe in the coastal districts of Calvados and Seine-Maritime and somewhat less so 30 miles inland from Normandy to Flanders. In 1955, the first generation was injurious over the whole of this area, and the second and third inland, and there was a similar trend in 1956. Notes on the bionomics of the fly are given, from which it is concluded that the size of the population depends on weather conditions in June and July, when the second generation is developing. High temperatures and drought at this period, which are common in the Paris region, prevent the development of large autumn and overwintering populations and so reduce the damage caused in spring, when conditions are usually favourable. Natural enemies [*cf. loc. cit.*] are of importance only when the host population is low.

Labeyrie (V.). **Influence des techniques de récoltes des haricots secs sur l'intensité des attaques de la bruche** (*Acanthoscelides obsoletus* **Say**). —*C. R. Acad. Agric. Fr.* **43** no. 3 pp. 138–140, 3 refs. Paris, 1957.

Acanthoscelides obsoletus (Say) oviposits on mature bean pods in the field in southern France, and field tests were carried out in 1954 to ascertain the effects of varying the periods between maturity, harvesting and shelling on infestation. The numbers of adults emerging per 100 bean seeds averaged 6·41 and 18·01 when the first period lasted two days and the second two and ten days, and 11·25 and 30·3 when the first lasted ten days and the second two and ten days, respectively. Prompt harvesting and shelling are therefore recommended when infestation is likely to be heavy.

Gersdorf (E.). **Beiträge zur holozyklischen Überwinterung von** *Myzodes persicae* **Sulzer im Bereich des Pflanzenschutzamtes Hannover im Winterhalbjahr 1953/54.** [Contributions on the holocyclic Overwintering of *Myzus persicae* in the Region of the Hanover Plant Protection Station in the Winter Season of 1953–54.]—*Z. PflKrankh.* **62** pt. 1 pp. 1–11, 18 refs. Ludwigsburg, 1955.

In view of the observation that *Myzus* (*Myzodes*) *persicae* (Sulz.) overwinters in the egg on *Prunus serotina* as well as on peach in Holland [*cf. R.A.E.*, A **40** 280, etc.], investigations were made in north-western Germany in 1953–54 on the possible primary food-plants of this Aphid there. They comprised field observations on various species of *Prunus* and tests in which Aphids were transferred to or from these in the open or in a greenhouse.

The intensity of the autumn migration to peach, for which data were available for several years, appeared to depend on the level of infestation of

crucifers in August–September, and the number of winter eggs laid on individual trees increased with the period for which the leaves persisted, very few being deposited when bad weather and low temperatures set in before 10th October. Hatching began in early March, and migrants developed in late May. *P. serotina* is fairly widespread in the north of the area, being planted for hedges and soil improvement in coastal districts, and oviposition was as common on it as on peach, even solitary trees or bushes in woods being infested. Hatching and later small colonies of fundatrigeniae were observed, these latter being produced from 4th May, slightly later than on peach. Migrants appeared in fair numbers at about the same time as on peach. In transfer tests, males, gynoparae and oviparae from *P. serotina* or peach settled on *P. serotina* and eggs were subsequently laid, though in small numbers; a few fundatrices hatched in spring from eggs laid by transferred oviparae.

The only other species of *Prunus* on which winter development occurred were *P. nana* [*cf. loc. cit.*], on which fundatrices and fundatrigeniae were seen in spring, and *P. serrulata*, on which eggs were laid as readily as on neighbouring peach, fundatrices hatched in early March and migrants developed in late May, but these trees are of little importance and unlikely to contribute significantly to the overwintering population.

Heddergott (H.). **Zur Biologie und Bekämpfung des Erdbeerwicklers *Acleris* (*Acalla*) *comariana* Zell.** [On the Bionomics and Control of the Strawberry Tortricid, *A. comariana*.]—*Z. PflKrankh.* **62** pt. 4 pp. 220–235, 18 figs., 17 refs. Ludwigsburg, 1955. (With a Summary in English.)

Acleris comariana (Zell.), all stages of which are described, has for some years caused increasing injury to strawberry in north-western Germany. It has two overlapping generations a year, overwintering in the egg stage, and development is completed in about two months in summer. The eggs are laid on the leaves, usually singly, and the larvae feed on the lower surfaces of the latter, covering themselves with threads and spinning the leaves together to form a shelter in which they later pupate. Parasites of the larvae are rare, the only ones recorded in 1953–54 being *Microgaster laeviscuta* Thoms. and *Copidosoma tortricis* Wtstn. Numerous experiments on control were carried out in 1954, mostly in the laboratory, and these showed that dusts or sprays of DDT or parathion were very effective against the larvae, and much more so than other organic insecticides.

Thalenhorst (W.). **Zur Kenntnis der Fichten-Blattwespen. III. Die Apparenzen der Diprionini.** [Contributions to Knowledge of the Spruce Sawflies. III. The Times of Appearance of the Diprionini.]—*Z. PflKrankh.* **62** pt. 6 pp. 353–361, 5 figs., 12 refs. Ludwigsburg, 1955. (With a Summary in English.)

The investigations described in the earlier parts of this series [*R.A.E.*, A **44** 350, etc.] were supplemented by similar observations in the Harz region of Germany in 1949–54 on the three Diprionine sawflies that infest spruce there. These are *Gilpinia abieticola* (D.T.), *G. hercyniae* (Htg.) and *G. polytoma* (Htg.), and they usually have two generations a year. Adults of all three were taken in almost every month from late April to mid-August, but those of *G. polytoma* appeared to be absent between late June and early July. Adults of the overwintered generation of all three species had two main flight periods, in April–May and in June, giving rise to larvae that

developed between late May and late July and between July and early September, respectively, and those of the first generation emerged in late July and August and gave rise to larvae that developed from mid-August. Although the normal cycle was bivoltine, there was a strong tendency for second-generation larvae of *G. hercyniae* to give rise to adults during the second emergence period of the following year, and for larvae of all species resulting from this second period of flight to remain in diapause until the corresponding period of the next or even a subsequent year, indicating the existence of a univoltine strain. The cycles are probably not fixed, however.

Jones (F. G. W.). **Sugar Beet Pests.**—*Bull. Minist. Agric.* no. 162, vi + 63 pp., 16 pls. (8 col.), 14 figs. London, H.M.S.O., 1957. Price 6*s*. 6*d*.

This bulletin on the insects and other pests that attack sugar-beet in Britain replaces the relevant sections of one issued in 1935 [*R.A.E.*, A **23** 354]. Apart from an introduction including notes on insecticides and their uses, it consists of a guide for the identification of pests from the symptoms caused, a section on the habits, injuriousness and control of the pests that attack the seedlings, of which the most harmful are wireworms, and a similar section on pests of the established crop, of which the most important are *Aphis fabae* Scop. and *Myzus persicae* (Sulz.), the vectors of virus yellows.

Kho (Y. O.) & Braak (J. P.). **Reduction in the Yield and Viability of Carrot Seed in Relation to the Occurrence of the Plant Bug *Lygus campestris* L.**—*Euphytica* **5** pp. 146–156, 2 pls., 5 figs., 10 refs. Wageningen, 1956. (With a Summary in Dutch.)

Low yields and poor germination of carrot seed are a problem in Holland, as in many other countries, and investigations on the cause were begun in 1951. Preliminary observations showed that fertilisation and initial development of the endosperm took place normally, but that there was a subsequent check in seed development, accompanied by disintegration of the contents of the ovule. *Lygus campestris* (L.) was found in numbers on carrot seed crops, and examples of this Mirid caused reductions of seed production, with the same macroscopic and microscopic symptoms, when caged on carrot umbels. They caused not only a reduction in seed production, due to abortion of the endosperm and embryo, but also a reduction in the germinating ability of full-grown seeds due to embryolessness [*cf. R.A.E.*, A **44** 405, etc.; **45** 483]. The reduction was greater when the bugs were caged on the umbels before or during anthesis than when they were added after it.

Papers noticed by Title only.

Simmonds (F. J.). **A List of the Coccidae of Bermuda and their Parasites.**—*Bull. Dep. Agric. Bermuda* no. 30, 12 pp., 3 refs. [Hamilton] 1957.

Colless (D. H.). **An improved Technique for permanent Mounts of small Insects and Nematodes.**—*Bull. ent. Res.* **49** pt. 1 pp. 45–47, 2 refs. London, 1958. [*Cf. R.A.E.*, B **46** 70.]

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INDEX OF AUTHORS

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CONTENTS.

[*Continued on p. iv of cover*

CONTENTS—*cont.*

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